Heating and Ventilating

For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning

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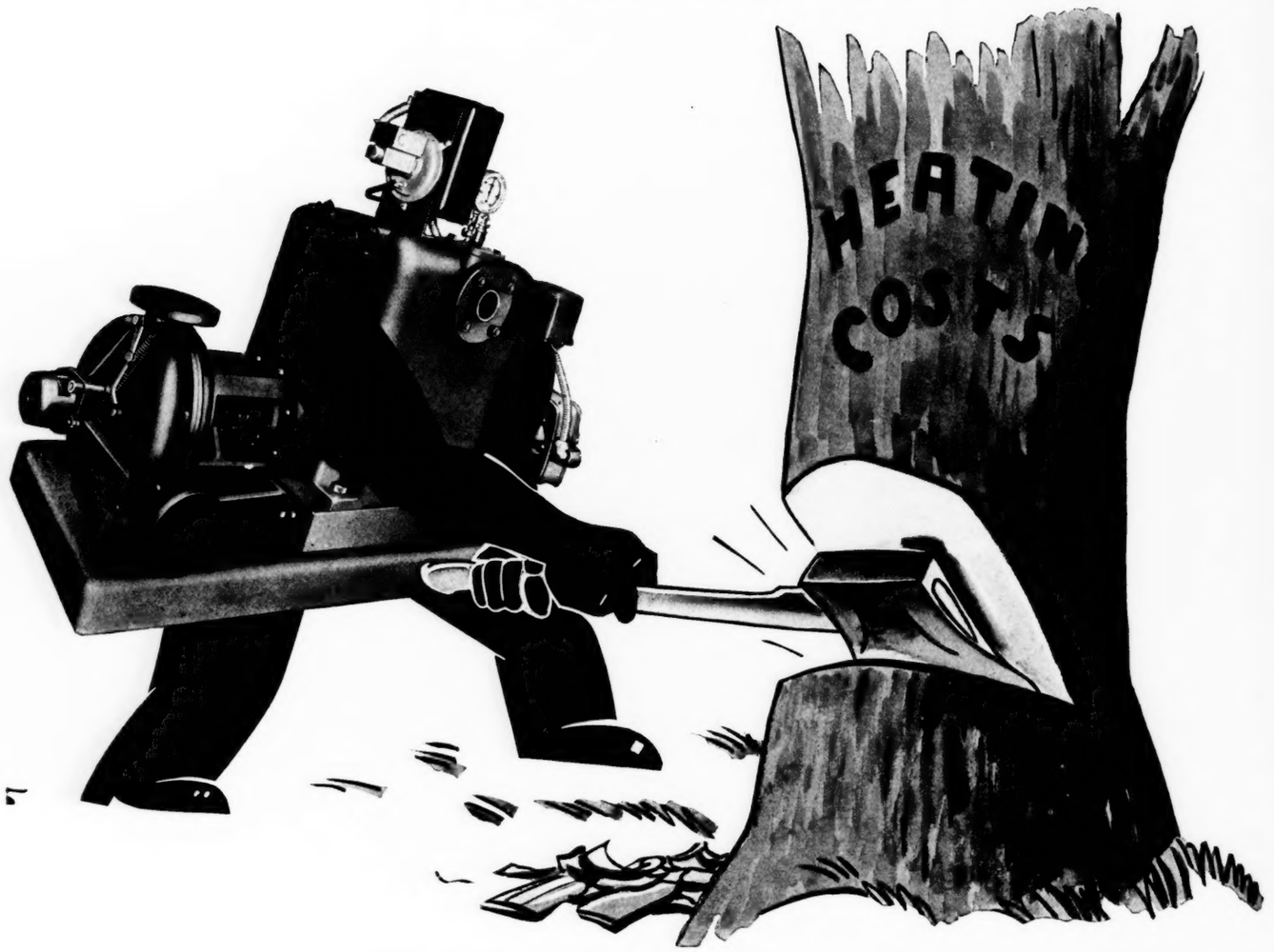

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SOUTH NORWALK, CONNECTICUT, U. S. A.

A New Development in Water Vapor Refrigeration†

By PAUL BANCEL‡

WATER as a refrigerant, especially for air conditioning jobs, has come into prominence within the past two or three years, and applications of the steam-jet apparatus for this purpose were numerous during the past few months.

There is another way of using water as a refrigerant in which a power-driven compressor takes the place of the steam jet. Recall that the function of the jet is to compress the vapor which is evaporated from a body of water kept at a temperature low enough to do the work wanted. In order to replace the jet the compressor must be able to do its job. This consists of picking up a large volume of vapor at very low pressure (high vacuum) and compressing it enough so that it can be condensed into liquid with the cooling water available. In order to permit a compact machine and still handle the large volume necessary, a rotating compressor running at high speed is the indicated form. It amounts to a steam compressor and is really a steam turbine designed for compressing instead of for expanding the steam as the familiar turbine does.

The design problem in arranging such a machine is difficult and was described recently in a paper by Paul Bancel wherein the author outlines the principal considerations and illustrates the resulting machine. Abstracts from the paper follow.

—EDITOR

An enormous volume of highly attenuated water vapor had to be compressed to a pressure compatible with ordinary condensing water supplies. Since there would be no burden of steam load as with steam jets, a somewhat better vacuum or lower back pressure could be expected with the centrifugal machine and the possible discharge pressures were set down as 1½ in. to 2 in. absolute (28 in. to 28½ in. vacuum). While these pressures might appear low, the ratio compared to a suction pressure of say 0.36 in. was surprisingly high—4½ to 6 times. This called for severe duty in the compressor.

In terms of a centrifugal compressor working with atmospheric intake, these ratios were equivalent to discharge pressures of 50 lb. to 75 lb. gauge. A compressor for 100 tons would need to have about 35,000 cu. ft. capacity and such a machine were it built to operate with atmospheric air, discharging at 50 lb. to 75 lb. pressure, would require as many as 10 stages and 5,000 hp. to 7,000 hp. driving power. Manifestly such a machine would be entirely unsuited for compressing 35,000 cu. ft. of low pressure vapor requiring less than 100 hp. Furthermore, it was not to be expected that highly attenuated water vapor would behave in the same way as air or gases for which the design factors were well known. Considerably less compression could be expected with water vapor than with air. To add to the difficulty it was imperative that the machine be absolutely tight against air leakage in all joints and stuffing boxes. It is little wonder that the water vapor cycle has been considered a theoretical curiosity.

The condenser, while small as compared to ordinary power house units, presented rather difficult and unusual problems. The discharge vapor would be superheated and condensation under these conditions was known to be difficult. A relatively high vacuum or low absolute pressure had to be maintained when using a minimum of condensing water and air removal power. The low water consumption called for sufficient equivalent tube length or number of passes so that the water would be heated as closely as possible to the vacuum temperature. The efficient removal of the unavoidable air leakage called for counter current cooling to as near inlet condensing water temperature as possible.

Enough has been said to sketch the complexity of the problem and the numerous difficulties confronted. The mere assembly of the component parts then available would be ridiculously impractical, costly, and inefficient. Each problem, however, was reconsidered in the light of the specific application, and the solutions developed combined into a full size experimental plant. The compressor was turbine-driven and of large capacity. Suction and discharge were at the top; the evaporator was cylindrical and fitted in various ways for studies of water distribution, separation, and removal. The condenser was above the evaporator and of the multi-pass counter-current type.

Extensive experiments were conducted. It was demonstrated that the cycle was entirely practical and the anticipated reactions to load variations proved. The result was a commercial machine illustrated in Fig. 1. The compressor is set upon a base which also forms the evaporator and the condenser is attached to the compressor discharge, thus producing a compact simple assembly. No detailed description of the machine shown is necessary. Standard sizes ranging from

†Abstracted from a paper presented at the 26th annual meeting of the American Institute of Chemical Engineers.

‡Manager, Condenser Dept., Ingersoll-Rand Co., New York.

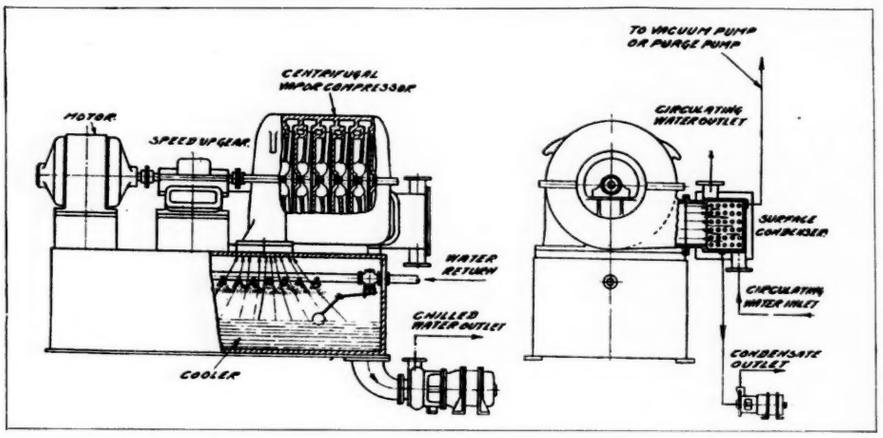


Fig. 1. Diagram of centrifugal compressor for handling water vapor. Note location of cooler in the base and surface condenser at the outlet.

50 tons to 300 tons are available. Instead of the motor with speed-up gear a direct-drive turbine can be used. Speeds are from approximately 7,000 to 10,000 revolutions depending on size, which agree with recent practice in high efficiency small turbine design.

[Regarding the economy of operating such a compressor the author writes the following.—Ed.]

The theoretical power consumption for adiabatic compression of water vapor from 50° to 86° (the refrigeration standard) and alternatively to 95° for example, are given below:

	Suction Temp.	Saturated Discharge Temp.	Adiabatic Hp. per Ton
Water Vapor	50°	86°	.371
Water Vapor	50	95	.476
Ammonia	35	86	.548
Ammonia	35	95	.658

The theoretical horsepower requirements with ammonia are given for comparison at suction temperatures of 35°. Due to the direct evaporation of water at 50°, the theoretical horsepower is markedly less than with ammonia, which in turn is the lowest of all common refrigerants.

The brake horsepower requirements of actual refrigerating units involve many factors of design and proportion; of these the efficiency of the compressor itself is probably most important, and there can be no question of the fact that a centrifugal compressor is usually less efficient than a reciprocating machine. This, however, is offset in this instance by the lower theoretical power. As a result the brake horsepower requirements of the centrifugal unit may be said to compare favorably with any type of refrigeration, frequently being less.

[Because of being a centrifugal machine the new compressor operates with characteristics peculiar to machines of this type, and they are described in the paper in the following fashion.—Ed.]

In general, the centrifugal unit is operated at constant speed. Under this condition and without any other adjustments, reduced tonnage is automatically reflected in reduced power, approximately in proportion to the tonnage. The unit simply floats on the load.

This remarkable feature of the centrifugal vapor unit has been fully verified in test and commercial operation. It follows from certain fundamental relations of evaporator, compressor, and condenser, and the interrelation of their characteristics.

Fig. 2 shows a typical volume characteristic of a centrifugal compressor; as the volume decreases the ratio of compression increases and over the designed range, there is a flat efficiency curve. The power is shown by line P; at part volumes the brake horsepower decreases but not proportionately. A second line P_1 below P shows the power for vapor of lower density. Within limits, a decrease in density at fixed volume results in an equivalent reduction in power. Now, with decreasing load, a change occurs in both volume and density, but for simplicity they can be considered as if there were two distinct phases or steps.

> First, a decrease in volume proportionate to the decrease in load as from A to B. The power then decreases along the curve P from point A to B.
> Second, a decrease in density and increase in specific volume which now increases the total volume to intermediate value C. However, due to the lower density, the power is now determined by lower line P_1 and the absolute value at C is less than at B.

Decreased density at reduced load is the result of reduced suction pressure which in turn is due first to the greater ratio of compression which the compressor can generate at reduced volume. Secondly, in most cases the condenser pressure decreases with reduced load and as this is reflected at the suction of the compressor the evaporator pressure is further reduced in density. In fact, there is frequently a cumulative effect because there is a tendency for the temperature of the condensing water to be colder at times of part loads, particularly in the case of small supplies or where cooling towers are installed. The three factors—the greater compression ratio available, the lighter heat load on the condenser and the colder condensing water, singly or combined, tend to reduce suction pressure and density.

The characteristics plotted against tonnage are shown in Fig. 3. Condensing water quantity is maintained constant for all three curves of each group; in each group the center line corresponds to rated maximum condensing water temperature, the upper one an extreme maximum 5° hotter and the lower one an average 5° lower. Horsepower and chilled water temperature are seen to be approximately parallel straight line functions of the tonnage.

If constant chilled or return water temperature is desired in a process, this can be readily obtained by mixing. For example, suppose that the full load conditions are 500 g.p.m. cooled from 55° to 50° and that 55° return water is desired at a part load; assume further that this part load corresponds to the 45° capacity point of the machine; then only part water is admitted

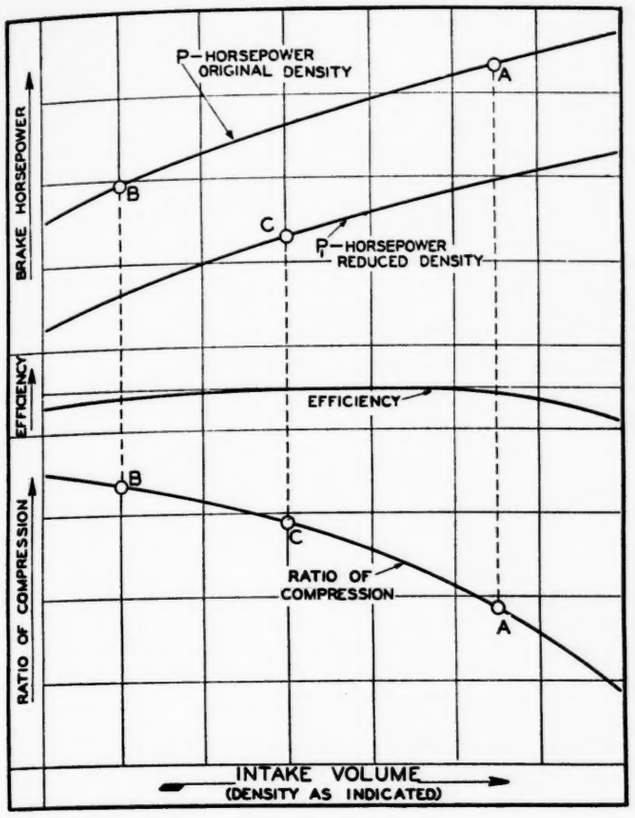


Fig. 2. Chart showing operating characteristics of the compressor.

to the evaporator and chilled from 55° to 45°, the remainder of the 55° water being mixed with 45° water under thermostatic control. To make clear what is occurring it should be remembered that the quantity of chilled water has no influence of itself on the load; the tonnage is determined by the product of quantity admitted to the evaporator and the range of cooling.

In a great many processes, however, the lower water temperature is highly desirable in increasing output, or improving quality. In air conditioning the lower dewpoint attainable is nearly always desirable. In all such cases the machine is simply allowed to float on the load without any by-passing or mixing.

[Ability to handle overloads and inherent reserve capacity are always interesting considerations, and the centrifugal compressor differs from the usual refrigeration machine in important ways. On the general subject of reserve capacity the paper goes on as follows.—Ed.]

At constant intake volume the weight of vapor compressed will increase with temperature and density as follows:

50°—Specific Volume = 1700 cu. ft. per lb.
55°—Specific Volume = 1430 cu. ft. per lb.

$$\text{Per cent weight at } 55° = \frac{1700}{1430} = 119\%$$

Actually, however, the tendency with fixed condensing water conditions is for the volume compressed to actually increase, because the higher suction pressure tends to reduce the ratio of compression demanded. The actual increase in capacity for 5° increased chilled water temperature is therefore more nearly 25% than 19%. It follows the straight line relationship of Fig. 3. For a moderate overload the increased chilled water temperature is very slight—a few degrees.

This is to be contrasted with the very sharp increase in chilled water temperature in the case of machines using a refrigerant. A small overload may readily increase chilled water temperature 10°. Two fundamental differences will be seen to account for this:

First, the change of density with increased temperature is more rapid with water vapor than any common refrigerant. This means that for a given increase in temperature, the weight compressed by a machine of fixed volumetric capacity increases in greatest proportion, with water vapor. Ammonia, dichlorodifluoromethane (freon), methyl chloride, etc., all exhibit about the same proportionate density changes with saturation temperature and the comparison with water vapor is as follows:

	Percentage Increase in Weight per Cu. Ft.		
	Water Vapor	Ammonia	Freon
Increase in Chilled Water Temp. 50° to 55°	19%	....	....
Increase in Refrigerant Temp. 35° to 40°	....	10%	9%

In the second place, the heat of the chilled water must be transferred through tubular surface, and any increase in load must be reflected in increased temperature difference; that is, the water must be hotter relatively to the evaporating refrigerant in order to transmit the greater amount of heat.

In addition, a third influence should be considered—the effect of scale or fouling on the efficiency of heat transfer. This tends to decrease the capacity at fixed

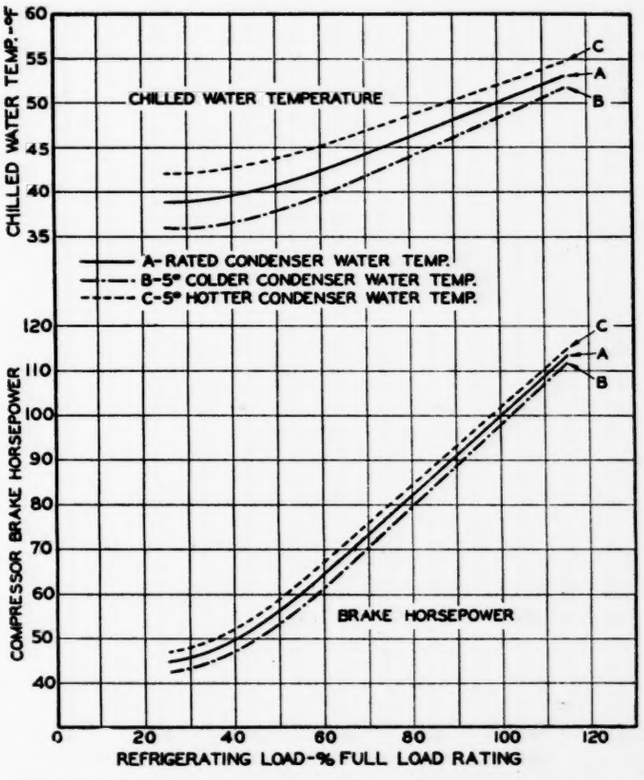


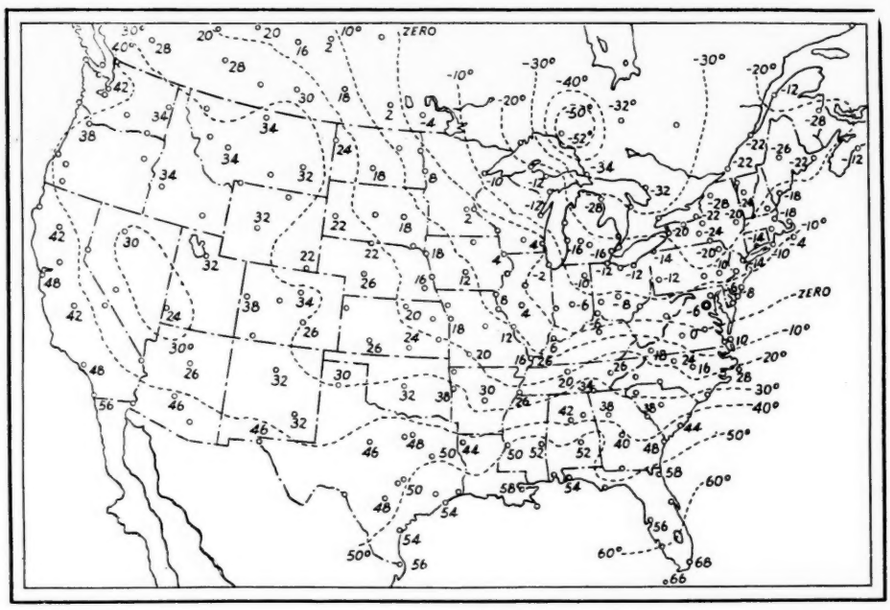
Fig. 3. Operating characteristics, showing variation of horsepower and chilled water temperature with varying loads and condenser water temperatures.

chilled water temperature and also to increase the steepness at which the temperature increases with load.

Reserve capacity against excessive temperature of condensing water with the centrifugal vapor unit has already been shown by Fig. 3 in which lines "C" are for hot water. The effect of a 5° increase in condensing water temperature is a corresponding increase in condensing pressure which is reflected in higher absolute pressure in the evaporator. This increase in suction pressure reduces the vapor volume, however, and the ratio of compression attainable increases; this counteracts severe increase in evaporator pressure and temperature. The chart shows the increase in chilled water temperature for 5° excessive condensing water temperature, and it is particularly noticeable that the spread actually decreases at the heavier loads. The horsepower curves also tend to converge.

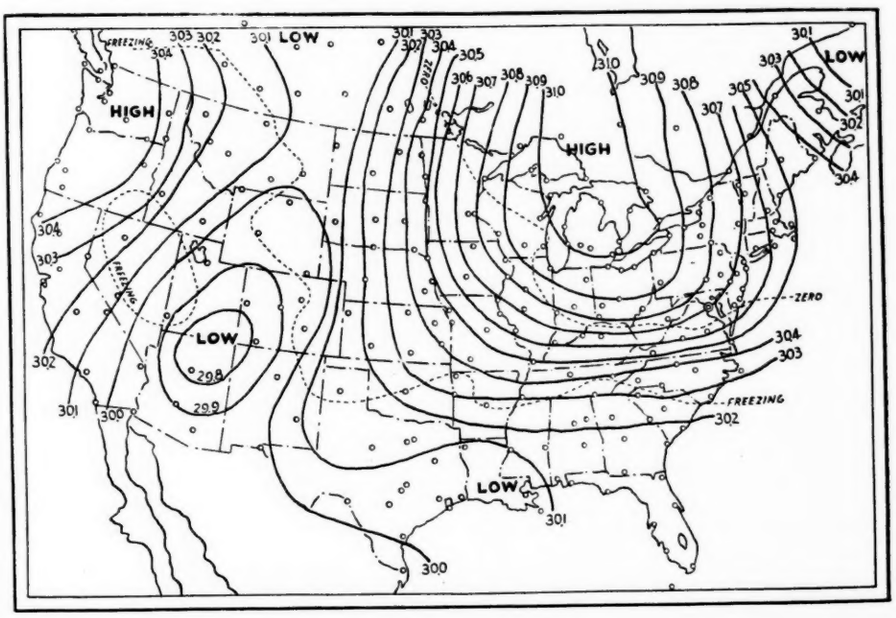
Standard centrifugal machines are not designed for cooling brine or for producing freezing temperatures. Temperatures from 35° up can usually be obtained, but in general low temperatures should not be specified except for part load. A chilled water temperature around 50° is the normal rating of water vapor units. While the overload characteristics are remarkable and highly valuable, the author wishes to emphasize strongly the futility of underestimating operating conditions in the expectation that any machine can make up for the users' carelessness in selection. Tonnage can be rated closely, but should not be under-estimated. Maximum condensing water temperature should be definitely anticipated and specified; this is particularly true with cooling towers and ponds which, in the author's experience, tend to be rated on more favorable wet bulb temperatures than may actually prevail for appreciable periods of time. This is all the more important if the greatest tonnage is most likely to occur at times of extreme atmospheric conditions, thereby producing cumulative effects.

Records for Cold Broken on February 9



THE chart to the left shows the temperatures at 8 a.m. on the record-breaking cold day of February 9, the time being that at the 75th meridian (Washington). Note that the cold wave was not so noticeable west of the Mississippi.

Charts from official data of the New York office of the U. S. Weather Bureau.



THE chart to the right shows the barometric readings, in inches of mercury, at 8 a.m., February 9. Extreme cold was registered in the region north of Lake Superior, this same location being the center of the "high" area, and the map shows the relation between the barometer and the temperature during such waves.

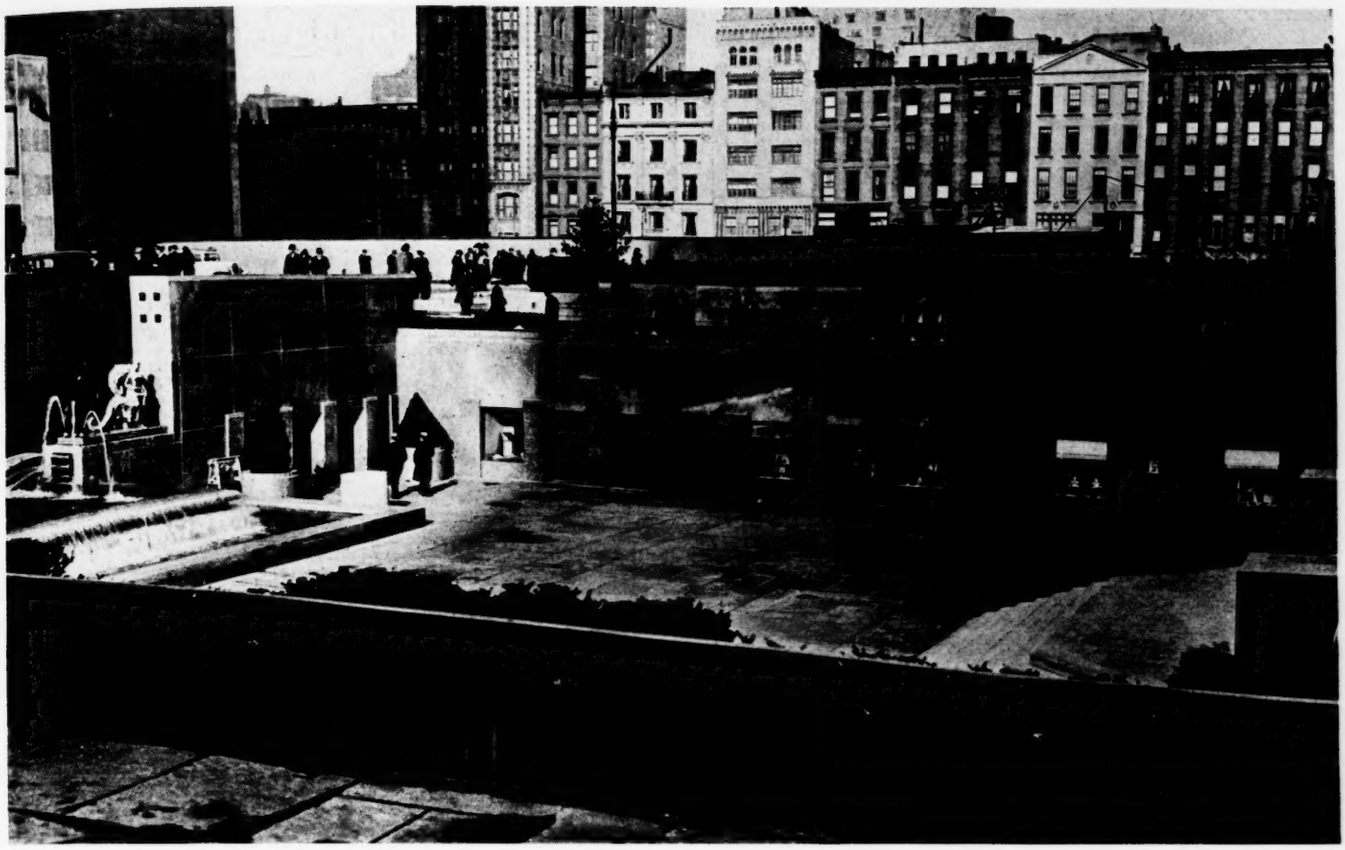


Fig. 1. The Sunken Plaza in Rockefeller Center, reached by a 60-ft. wide Promenade extending from Fifth Avenue. The camera is looking North.

Rockefeller Center Air Conditions Sunken Plaza Shops

By ANDRE MERLE†

THE Sunken Plaza—the heart of Rockefeller Center in New York—is reached from Fifth Avenue by a massive stairway, the Avenue being 18 ft. above the Plaza. Fig. 1 shows the Plaza, the entrance from the Avenue being at the right, while to the left of the Plaza is the 70-story R.C.A. building. Shops are located in the walls of this area, as shown in the illustration, additional shops being built under the walks in the foreground, these being symmetrical with the ones facing the observer. The approach from the Avenue is between the two buildings facing Fifth Avenue, Le Maison Francaise and the British Empire Building. Against the west wall of the Plaza is the magnificent Prometheus Fountain, shown at the left of Fig. 1. At night the entire shopping area is clearly illuminated by flood-lighting of many colors. This shopping area is most spacious, being 95 ft. wide and over 125 ft. long. The shops, which have an active area of 10,000 sq. ft., are supplied with approximately 1,000,000 cu. ft. per hr. of conditioned air.

†Air Conditioning Engineer, Staff of Clyde R. Place, New York.

Central Refrigerating Plant

Centrifugal refrigeration machines for cooling the shops are located in the sub-basement of the adjoining R.C.A. Building. These machines have a combined capacity of 600 tons per 24 hr. They were designed primarily to chill spray water for the stores located in the R.C.A. Building. As the tonnage requirements for the Plaza Shops are less than 50 tons, chilled water is piped over from the main 600-ton refrigerating room. The distance from this central plant to the Plaza conditioning equipment is about 450 ft. for the northern section and 350 ft. for the southerly one. Both the shops in the Plaza sections and the R.C.A. Building are operated on approximately an identical schedule. A central refrigerating plant was therefore the most economical from an installation and operation view point.

Conditioning System

Due to the large ground area covered by the shops, and in order to secure better control, two complete sets

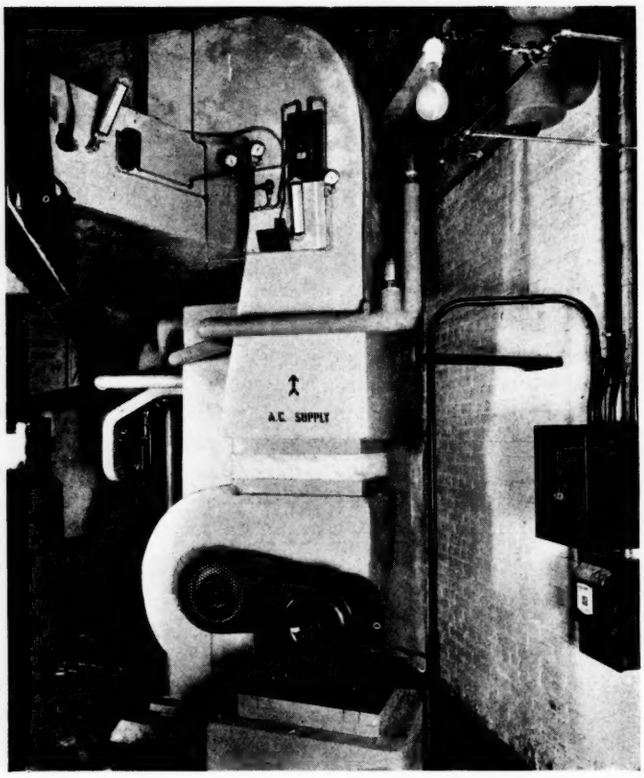


Fig. 2. Main supply air fan for southeast apparatus. Note control thermostats and gauges.

of air conditioning apparatus are installed, fully automatic, and with independent supply and return air distribution ductwork. Shops with a south or west exposure to the sun are on system A while the north and east shops are conditioned by system B (see Fig. 5). This arrangement permits securing closely controlled conditions of both temperature and humidity throughout the whole area.

The automatic control system is of the balanced temperature and humidity type and sensitive to slight differences. The only manual operation required is the change from winter to summer. Of special interest is a new design dehumidifier thermostat placed in the spray chamber to control and regulate the dewpoint temperature. This instrument is the basic control feature. Fans, pumps, dehumidifiers, heaters, and the other apparatus are standard.

Distribution

Air distribution is of the ejector type with high-speed, double-duty outlets fed from supply ducts located above the show windows. Outlets are on the side wall close to the ceiling. Fig. 3 illustrates a typical shop, with the location and style of air outlet clearly shown. The air is discharged horizontally at an initial speed at the outlet in the neighborhood of 1800 f.p.m. It diffuses within the room assisted by the secondary air current created by ejector action.

In store conditioning systems, the method of exhausting air for re-use is important. As the side wall space is particularly valuable for display purposes it should be free of grilles. Ordinarily, a ceiling-type return would be installed in rooms of this kind. It was not felt necessary to install an equal number of supply and exhaust or return air outlets. On the contrary, centralized returns actually improve the circulation within large areas. The presence of a corridor interconnecting the plaza shops with the R.C.A. concourse level and the French and British Buildings permitted the use of a central return grille by locating it in the main corridor. Relief louvered openings were provided in each connecting door. Large revolving doors subdivide the various areas, individually. In this manner, the main corridors and shops are fully air conditioned. A positive pressure is maintained in all of the shops.

Filters

Two sections of glass wool filters placed in the fresh air intakes eliminate the possibility of entrained dust or soot entering the system. Filtering the fresh air prevents to a great extent the possibility of clogging of the

Fig. 3. Typical air distribution duct with high-speed special type air diffusers near ceiling.

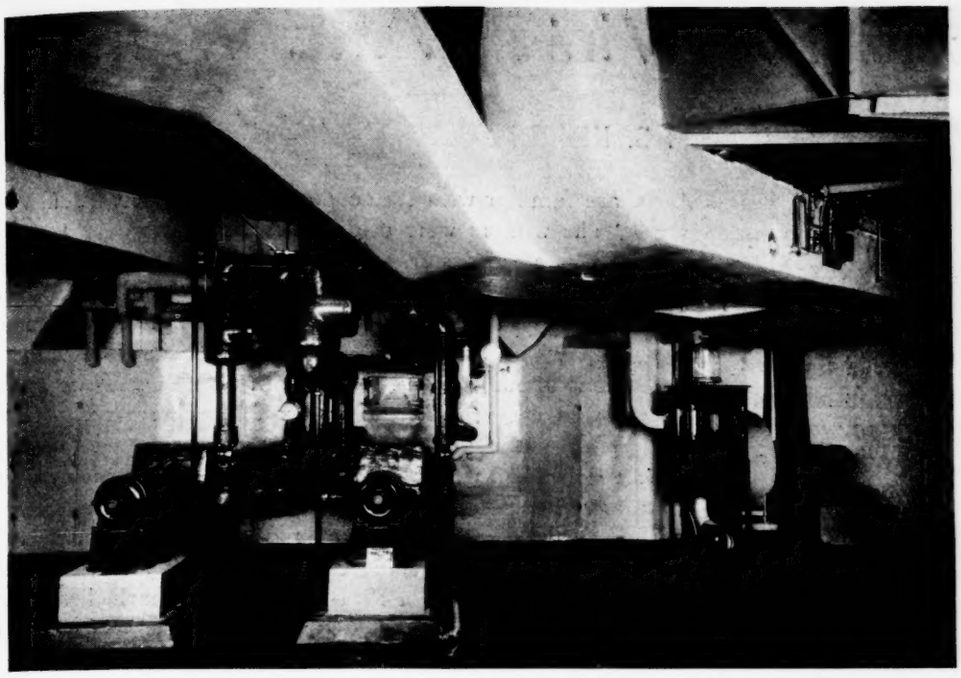


Fig. 4. One of the central station air conditioning systems for the Plaza stores, northeast section.

spray nozzles. All air circulated is both filtered and washed. Ionization equipment, functioning automatically, is also included. Corrosion retarding compounds are also injected into the dehumidifier spray water and a pH value between 7.5 and 8.5 is sustained.

Humidification

Chilled water circulated in the spray type dehumidifiers is pumped from the main refrigerating plant by a centrifugal pump which delivers over 10,000 gal. per hr. of chilled water (see Fig. 4). A novel arrangement of control using a three-way valve permits the exact quantity of water to pass to the spray pumps or bypasses it to the dehumidifier, basin, or tank. The three-way valve (see Fig. 5) allows the spray pump to circulate chilled water, warm water, or a mixture of each. As a constant volume is sprayed each minute, all excess water delivered by the chilled water pump must be returned and re-chilled. On the average systems of the open type, the warm water is returned to the refrigerating room by gravity. This would be difficult in this case due to the length of pipe runs (450 ft.) and the slight difference in elevation. An economical gravity system would also have made it necessary to undertake expensive trenching through solid rock. A pump was therefore used to return the re-use water back to the large (8 ft. × 30 ft. × 7 ft. 6 in. deep) concrete receiving tank under the refrigeration room floor. A very accurate balance is required at each dehumidifier. All of the chilled water which is delivered, whether used or by-passed, must return to the receiving tank. Or to put it in another fashion, a constant supply of water must be delivered to the dehumidifiers. Two return pumps withdraw water constantly and the amount returned is equal to that delivered by the central chilled water pump. The sketch, Fig. 5, illustrates this arrangement diagrammatically.

Various schemes were suggested and the three-way valve arrangement finally selected. A balanced, accurate control resulted and the desired features of spray type dehumidification were obtained—complete air washing during all seasons, full automatic spray type humidification during the winter period.

The air conditioning equipment is that of B. F. Sturtevant Company, and was installed by Gillis & Geoghegan, Inc. All engineering was performed by the staff of Clyde R. Place.

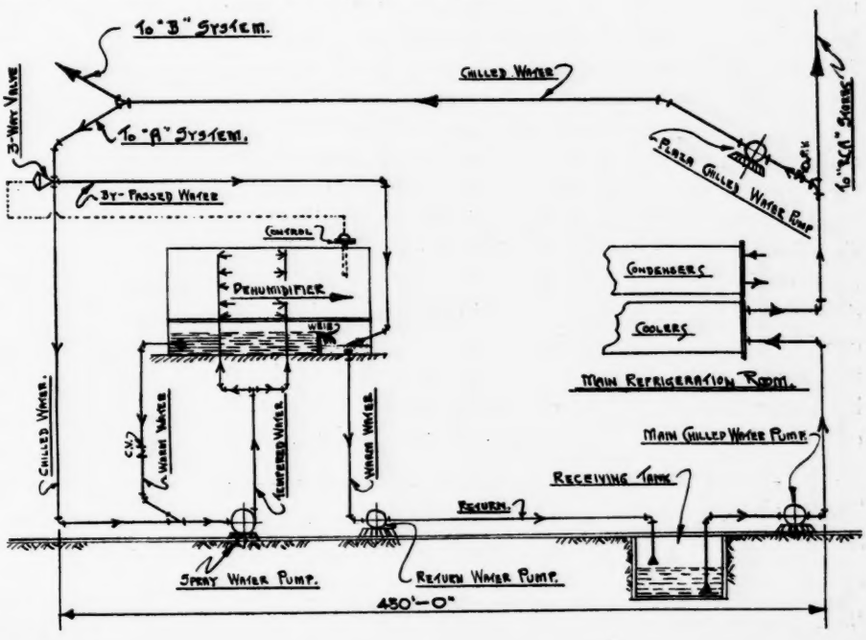


Fig. 5. Chilled water flow diagram.

Granddad is Right—Winters ARE Warmer†

By JOSEPH B. KINCER‡

After surviving two record-breaking cold spells and snow storms that paralyzed half the country, we publish this article with some diffidence. Even this last month's experience, however, is not sufficient to balance the data from weather bureau records collected over many decades, and we believe that the author has thoroughly established the points he makes.—Editor.

DIFFERENT kinds of weather come and go in comparatively brief, alternating spurts, as it were, or with short periods of irregular length—cool or cold, then warm, and vice versa—succeeding one another with a continuous recurrence that everyone takes for granted. However, an exhaustive statistical examination of these short-period temperature fluctuations fails to disclose any regularity that would afford a basis for forecasting future weather independent of the standard forecasting methods of the Weather Bureau, in which daily synoptic charts play an important role.

The phase of weather, or climate, that is attracting attention at the present time is not these short-period changes from warm to cool, and vice versa, for they are always present, but rather an apparent longer-time change to cool periods that seem to be less frequent and of shorter duration, and warm periods that are more pronounced and persistent. It has been thought that these fluctuations in temperature eventually neutralize one another, or smooth themselves out, when the long-time record is taken into account. In other words, meteorologists consider that climate, which is the normal run of the weather, for a long period of time, is a fairly stable thing, and that the average temperature for, say, any consecutive 20 years, selected at random from a long record, would not differ materially from that for any other consecutive 20 years so selected from that particular record. It appears, however, from the data presented with this study that the orthodox conception of the stability of climate needs revision, and that our granddad was not so far wrong, as we have been wont to believe, in his statements about the exit of the old-fashioned winter of his boyhood days. We are familiar with statements by elderly people, such as "The winters were colder and the snows deeper when I was a youngster," and the like.

Before taking up the matter of long-time temperature trends, a few facts, which prompted this study, and which have been responsible for numerous questions about a possible change in climate, may be cited. When we examine the winter temperature records for Washington, D. C., for example, it is found that for the last 21 winters, 1912-13 to 1932-33, inclusive, 18 have been warmer than normal; that every one of the last 13 of these has been mild, and that the warmest winter of record, going back considerably more than a century, was that of 1931-32. This is in marked contrast with "granddad's day," for the 19 winters of 1854-55 to 1872-73, 14 of which were colder than normal, with 1855-56 the coldest in more than 100 years. The record for New Haven, Conn., may be cited as another example. Here every one of the last 10 winters has averaged warmer than normal; so also have 18 of the last 21, and 33 of the last 45. This record, by the way, goes back to near the close of the Revolutionary War. Farther west, we pick up, at random, the St. Louis

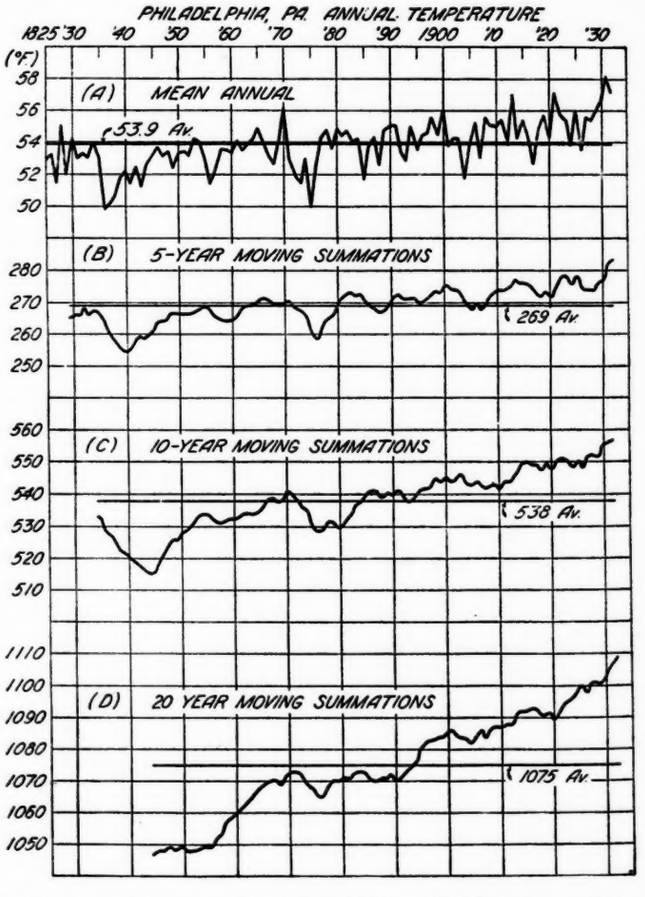


Fig. 1. Mean annual temperature, Philadelphia. (A)—Successive annual means; (B), (C), and (D), 5-year, 10-year, and 20-year, (respectively) moving summations of annual means.

†This article is abstracted by permission from the author's paper "Is Our Climate Changing?" which appeared in the September, 1933, *Monthly Weather Review*, publication of the Weather Bureau. As originally published, the article included numerous graphs as well as tables of mean temperatures for the different seasons for a number of cities.

‡Chief of Division of Climate and Crop Weather, Weather Bureau, U. S. Department of Agriculture.

record, which shows 13 of the last 15 winters to have had above-normal temperatures. These records are typical for the central and northern portions of the United States east of the Rocky Mountains.

It might be stated here, however, that the abnormally warm weather experienced in general for a long time past does not mean that cold periods have been entirely absent. On the contrary, the records indicate that occasional brief spells of abnormally cool, or extremely cold, weather are characteristic of prevailing high-temperature trends. The cold winter of 1917-18 may be cited as an example, coming at a time when the long-time trend was running comparatively high, and also the fact that the lowest official temperature of record for the United States—66° below zero—occurred in the Yellowstone National Park in February, 1933.

For a more fundamental study of the matter, we have adopted a system of moving 20-year summations of temperature data, employing the longest records available. That is, on the accompanying graphs, the first point represents the sum of the mean annual temperature data for the first 20 years of the record, or years Nos. 1 to 20; the second point a like sum for the years Nos. 2 to 21, and so on, step by step, throughout the entire record. This, of course is equivalent to the usual floating, or moving-average tabulation; summations were used instead of averages to simplify the operation and obviate residuals resulting from computation of means.

The records for the different seasons of the year show that the winters are the most erratic, with up-and-down trends of greater frequency and shorter duration than the other seasons. For the spring and fall the trends have been more uniformly upward, with fewer interruptions by short cold spells.

For the fall, winter, and spring seasons the averages in temperature for the past 20 years to and including 1933 are from 2.5° to nearly 4° higher than similar averages 60 or 70 years ago. Temperature records of other countries of the Northern Hemisphere, and also of the Southern Hemisphere, show strikingly similar conditions.

Fig. 1 is based on the temperature record of Philadelphia and illustrates the statistical method employed in developing long-time trends.

Sub B, Fig. 1, shows the data smoothed by 5-year moving summations. That is, the first point on the graph represents the sum of the annual temperature values for the 5 years from 1825 to 1829, inclusive; the second point a like sum from 1826 to 1830, and so on through the record. This brings out, more definitely, the general trend, but at the same time emphasizes short-period fluctuations.

Next, sub C, represents 10-year moving summations, and more graphically establishes the trend, while sub D shows the results of a 20-year moving summation tabulation. Here attention is invited to the fact that the sum of the annual temperature data for Philadelphia for the 20 years ending with 1844 is 1047°, and for the 20 years ending with 1932 it is 1109°. If doubt exists as to the realness of this remarkable showing,

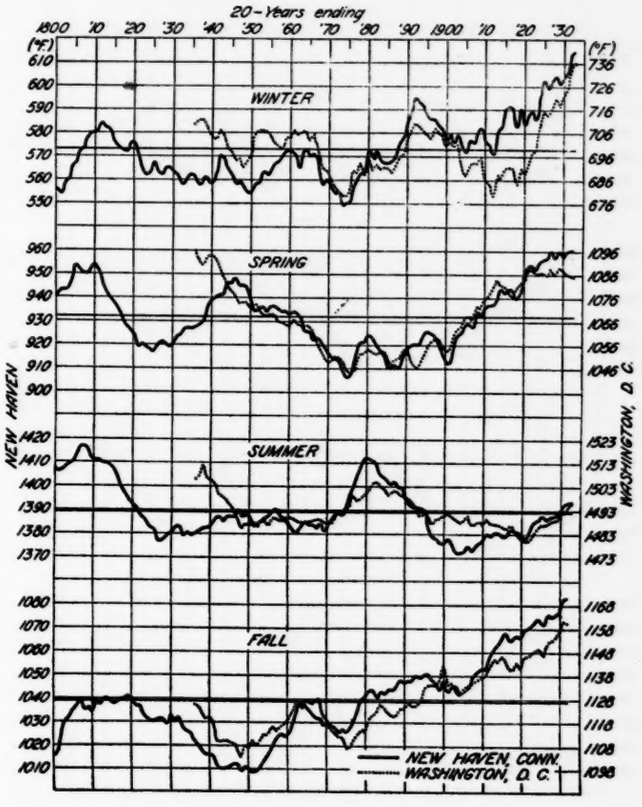


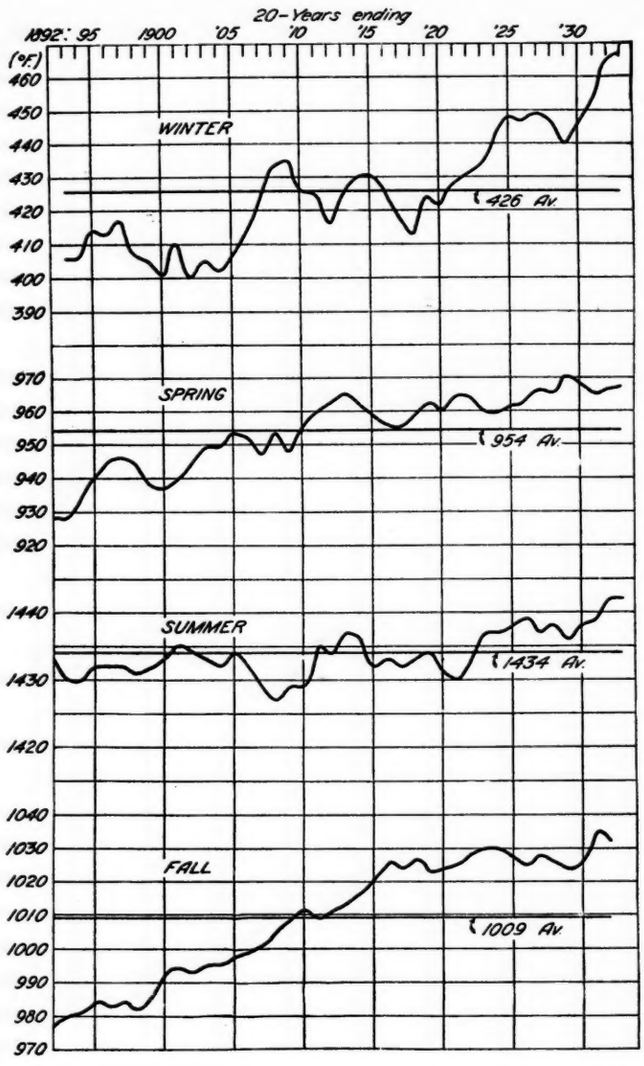
Fig. 2. Twenty-year moving temperature summations for the four seasons in New Haven, Conn., and Washington, D. C. Trend lines superimposed on a common base.

comparison with similar graphs for other stations in different localities and even different countries, discussed later in this paper, is invited.

Seasonal Trends

In Fig. 2 seasonal curves are presented for two long records in the eastern United States — New Haven, Conn., and Washington, D. C.—the former beginning with 1781, and the latter with 1817. These records cover well over a century of time and must be credited with offering interesting and corroborative testimony. The four seasons—winter, spring, summer, and fall—are charted separately and, to facilitate comparisons, the lines for each season are superimposed on a common base. The similarity of these trends is remarkable, considering the very considerable distance between the stations. The results show not only that present tendencies to abnormally high temperatures are widespread, even on a seasonal basis, but also by trend concurrence that the fundamental observational data are trustworthy, and are of such character as to afford complete confidence in their integrity.

There is some disagreement for a few years after the beginning of the Washington record but, from about 1845 on, the similarity is striking. A minor winter divergence appears about 1915 to 1920, due to unusually cold weather in Washington being much less severe, relatively, in New England, such as the War winter of 1917-18. An outstanding coincidence is presented in the summer trends during the last 25 or 30 years, largely in opposition to those of other seasons.



Examining these graphs more critically, we find in the case of the New Haven winters very definite, comparatively short-period fluctuations, as follows:

	Years
Rising, 1801-12	12
Falling, 1813-49	37
Rising, 1850-64	15
Falling, 1865-73	9
Rising, 1874-92	19
Falling, 1893-1912	20
Rising, 1913-33	21

Disregarding these comparatively minor fluctuations, there is an outstanding recession in the curve from a maximum about 1812 to a minimum in 1873, a period of about 60 years; then a pronounced rise up to 1933, or for more than 70 years. The Washington winter curve closely follows that for New Haven for 100 years, except for a short period just prior to 1920, previously mentioned.

With these graphs before us, the question, in passing, would seem pertinent, "What about granddad's old-fashioned winter?" The records for both stations show in the early seventies the winters for 20 years up to that time averaged 3° or more colder than for a like period ending with the winter of 1932-33. This is quite a difference in average winter temperature, comprising a span of 3 months, and for a period as long as 20 years.

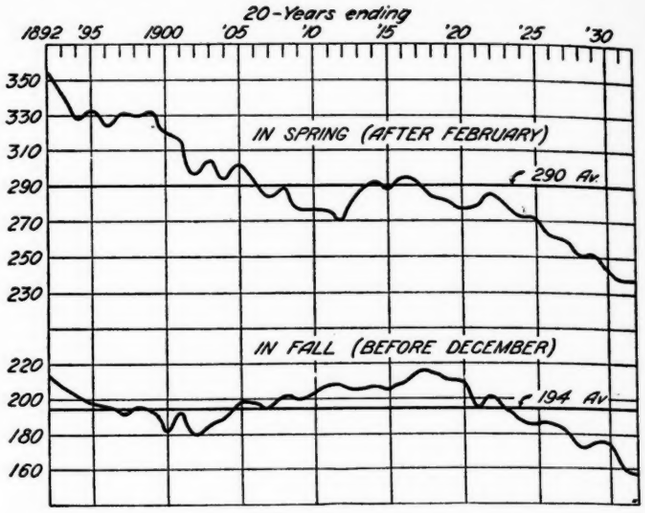


Fig. 4. (Above) Twenty-year moving totals of days with freezing weather in fall and spring in Washington, D. C.

Fig. 3. (Left) Twenty-year moving summations of seasonal temperature data for all weather-reporting stations in Iowa.

The trends for the spring months for the two stations show close agreement since about 1845, actually for more than 100 years, because the records extend back 20 years beyond the respective points on the graph. In the case of New Haven there is a comparatively short down, then up trend, with maxima about 1810 and 1845, and minimum in 1825. From 1845 there is a pronounced recession, in both curves, to 1875, or about 30 years; then an even more prominent rise up to the present, or for more than half a century.

For the summer, the highest points for the New Haven curve appear for the 20 years ending with 1807 and that ending with 1881, the maxima being about 75 years apart. The Washington record does not go back to the first New Haven peak, but the second crest of the latter coincides with a similar maximum for Washington in the early eighties. An interesting feature of these curves is the recent comparatively cool summers. In other words, following 1880, while the winters, springs, and falls were becoming definitely warmer, the summers were getting cooler. More recently they, too, show a recovery in the trend lines corresponding with the other seasons.

The fall months show the most remarkable trends in this series of graphs. Beginning with Washington for 1848, and New Haven for 1850, disregarding minor fluctuations, there is shown a very definite upward trend in the temperature curves to 1932; in other words, the falls in the eastern United States unquestionably have been getting definitely warmer for the last 100 years when the long-time temperature trend is considered. Fig. 3 shows confirmatory seasonal trends for the State of Iowa, based on the average temperature for all stations within the State for a period of 61 years from 1873 to 1933. The reader is again reminded that, in considering these curves, each successive point thereon represents data for the 20 years preceding the date of entry.

In concluding this study, other weather features di-

rectly related to general temperature conditions were examined such as the occurrence of frost in the fall and spring, the number of days in winter with certain low temperatures, the occurrence of freezing weather in the fall and spring seasons, the length of the winters, as indicated by the first frost in fall and the last in spring, etc. All of these confirm the general statement that we are in the midst of a period of abnormal warmth, which has come on more or less gradually for many years. An example of this auxiliary evidence is shown in Fig. 4, in which the general trend of the number of days with freezing weather in fall and in spring at Washington, D. C., is charted for a period of 60 years. It will be noted that for the 20 years ending with 1892 there was for the spring months (after February) a total of 354 days with minimum temperature 32° or lower, and for the 20 years, ending with 1933, this had dropped to 237 days, a reduction of one third from the early total, or an average difference of 6 days a year.

The following additional supporting evidence from the records of Washington, D. C., may be cited. The average number of days with freezing weather (minimum temperature 32° or lower) for the 3 winter months, December to February, for the 20 winters up to 1911-12 was 66 and for a like period, up to 1932-33, 57 days. Again, for the same periods, the average number of days with temperatures continuously below freezing (maximum 32°, or lower) was 15 and 10, respectively. That is, the average number of days with temperature continuously below freezing for the earlier 20-year period was 50% greater than for the latter. Also, the average length of the frost-free season (number of days from the last killing frost in spring to the first in fall) for the 20 years ending with 1906 was 188 days and for a similar period ending with 1932 it had increased to 199 days.

Effect of Air Conditioning on Factory Workers

AIR conditioning in commercial and industrial buildings is still new enough so that field studies to learn the effects on workers and products have not been made to any notable extent. They are just beginning to appear, and a recent booklet of the Industrial Sales Department of the Philadelphia Electric Company includes statements of findings on three installations in that city. Two of these are in offices of the company, while the other is at the plant of the American Cigar Company.

Of the studies in its own offices the company booklet summarizes the results as: "Taken together the two air-conditioned offices showed an average decrease in lost time of 45.4%. This reduction when applied to the general commercial average of 5.25 days lost per employee per year due to minor illnesses, and evaluated at $5 per day, represents a potential saving to industry of $11.90 per employee."

The studies are notable in setting up the results in terms of days lost per employee per year.

The study at the cigar company plant is summarized in these words: "The gross savings made from reduction in lost time, reduction in labor turn-over, reduction in rejects, and increase in production, amounted to $29,546 per year. Since the total owning and operating cost of the added air conditioning was $6,174.50 per year, there was an outright profit of $23,371.50 per year.

"According to the American Cigar Company, the installation has resulted in a general improvement in the health of their employees which is beyond evaluation."

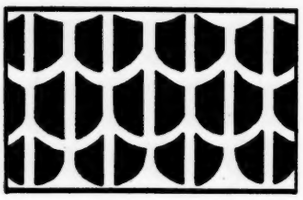
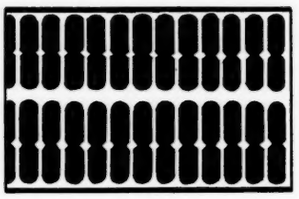
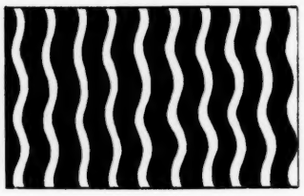
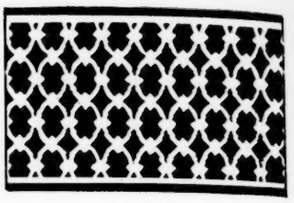
Mental Effort Produces No Heat

AN elaborate series of studies, recently completed at the Carnegie Institution, Washington, D. C., has revealed that mental effort is without significant influence upon the energy metabolism of the human body. In a practical sense, the investigations showed that the production of heat energy within the body by the oxidation of food is not materially increased by the accomplishment of mental work, as it is by physical effort.

For the tests six men and one woman, all university-trained, were selected as subjects, and the simple basal metabolism apparatus, in somewhat modified form, was used to determine oxygen consumption and carbon dioxide exhaust. The subjects, wearing light, comfortable helmits, fitting the neck so closely that no air could leak in or out, concentrated on mental arithmetic problems while reclining at rest.

The mental gymnastics produced a slightly more rapid pulse and an increased rate of respiration which resulted in an increase of oxygen consumption of 4% over the normal consumption when the mind and body are both at rest. The functioning of the brain, in itself, had nothing to do with the increased rate of oxidation within the body. So far as heat production is concerned, the metabolism of the average individual is increased by 9% over the basal, as compared with the 3% or 4% resulting from brain work. Such light feminine tasks as sewing increase the rate by 13%, and sweeping and dusting result in a metabolism rate that is 140% of the basal.

The studies were made by Dr. F. G. Benedict collaborating with Mrs. Benedict.

Characteristics and Advantages

A brief discussion of "heating effect" and of various convector grilles and

AFTER reading the previous article on the subject of gravity convectors the questions might well be asked "What is the difference between these convectors and an enclosed radiator?" and "What special features do convectors have to recommend them?"

The answer to the first is "none." The enclosed radiator group and the convector group are in some cases hardly distinguishable. After all, even the unenclosed direct radiator gives off part of its heat by convection, part by radiation. In the case of the more common types of non-ferrous convectors all of their heat is given off by convection. Some of the newer units, however, as for example, Types F1, 2, and 3 (illustrated in last month's issue) are so modified that they give off part of their heat by radiation and part by convection. In these cases we have called them "convectors" although in reality they are no more convectors than the ordinary unenclosed direct radiator.

The second question is really more to the point. The answer, however, depends on a number of considerations, some of which we will briefly discuss.

Heating Effect

About eight years ago the question of rating direct radiators on the basis of condensate was raised and, probably for the first time, examined skeptically. It is difficult to say just who first proposed the use of "heating effect" but prominent among the pioneers in this line were Brabbee, Frost, and Konrad Meier.

The term "heating effect" was thus used to express the *output* of a radiator. As pointed out by Meier, it is incorrect to assume that the input (as measured by the condensation) is equal to the output. This is rarely, probably never, true in engineering, and today it seems odd that this was not recognized in regard to radiator performance.

The word *efficiency* in connection with radiator performance had long been loosely used, but following the advancement of the ideas on heating effect it was recognized that the efficiency was the $\frac{\text{heating effect}}{\text{input}}$.

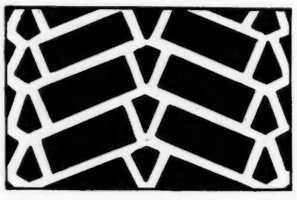
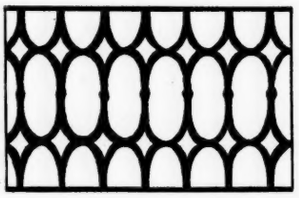
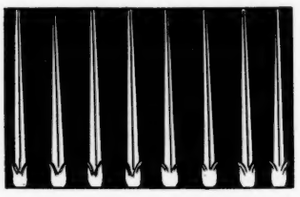
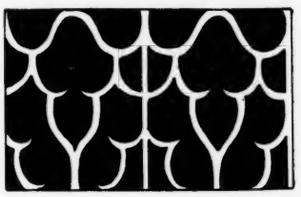
On paper the idea appears quite simple. The difficulty, however, was to devise a means of measuring the heating effect. This problem has never been completely solved, and has occupied the attention of investigators up to the present time. Among the most recent studies along these lines were those by Willard, Kratz, and Fahnestock at the University of Illinois, using a eupatheoscope for measuring the performance of radiators and convectors.

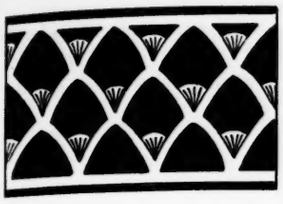
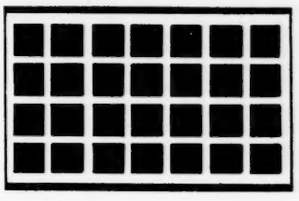
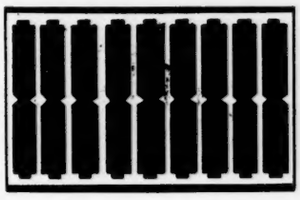
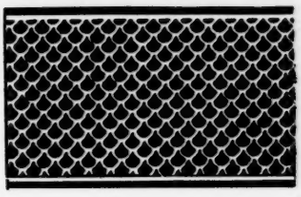
In general, then, the meaning of the term *heating effect* is the measure of the useful heat emitted by the device. The useful heat is that part of the total heat that actually warms the occupants. Several points are involved here, among them being the *air distribution* in the room, another, radiation losses.

To measure the air distribution a scale of vertical height is usually used. The desirable condition is one where ceiling temperatures are not appreciably above those in the occupied zone; that is, from the floor to 6 ft. above the floor. Heat used to maintain a high temperature in the zone above our heads serves very little, if any, to warm the occupants of the room.

Moreover, heat lost from a radiator or convector to the cold walls back of it is not useful heat, and the desirable condition would be one where this loss is reduced to a minimum.

According to laboratory results, the temperature

# of Convector Heaters—Part 2

other features of convectors, with illustrations available types of convectors.

gradient measured vertically in a room shows higher ceiling temperatures with an unenclosed direct radiator than with a convector when the two are compared with equal knee-height temperatures. To obtain such results, however, the stack height of the convector must remain within reasonable limits. As the stack height approaches that of the ceiling height we would expect to find the temperature at the ceiling increase. However, the capacity of the unit increases with the stack height, so that economy would require our considering and weighing against each other a number of points. These would be: At what stack height does the gain in capacity from increased height, with consequent lowered cost of element as the height increases, offset the cost of enclosing, and in addition to the above, at what height does the loss in heating effect result in such increased operating cost that installation cost savings are cancelled.

Tests at the University of Illinois have shown that when the same temperature—68°—is maintained at a height of 30 in. when convectors or radiators are compared, the quantity of condensation is a measure of the heating effect of the units. In these tests, thermocouples were used to measure the temperatures. The question then arose as to whether this conclusion would be true if a large instrument more nearly the size of the human body were used as an index of the combined effect of radiation and convection. The eupatheoscope satisfies this requirement, and further tests were conducted using this instrument.

These later experiments showed that the previous conclusion was correct, except for slight correction as to quantity. The earlier tests had credited the convectors with too great a heating effect. The important conclusion was that maximum credit to be given to the heating effect obtained does not exceed 10%.

The better heat distribution in the room, then, constitutes one of the major advantages claimed for convectors. Other good points include:

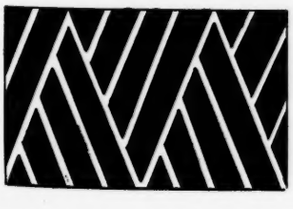
(1) The concealed feature.
(2) The light weight (particularly where the convector is non-ferrous).
(3) Vertical convection along the walls, resulting in dust streaks, is reduced (not a point where top openings are used in recessed heaters or cabinets).

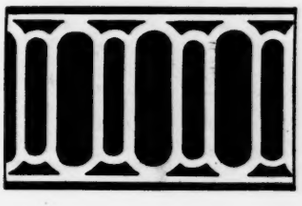
Other things being equal, the concealment of a convector constitutes a real advantage in the way of appearance and space-saving. In this respect, it is interesting to observe that the concealed convector and the jacketed boiler were the first important advances in the heating business along the lines of improving the appearance of what had been rather unattractive devices.

Ease of handling is among the advantages accruing from the lightweight feature. Here, however, is a point on which the convector people divide into two opposed camps. The one group, using as it does copper, aluminum, or brass, stresses the lightweight. The cast-iron people, on the other hand, point out the low heat capacity of the non-ferrous type, which in turn is spoken of as a disadvantage by the non-ferrous proponents. It appears to us that both low and high heat capacity units have their advantages and that it would be difficult to claim a complete advantage for all conditions for either type.

Possibly no single idea proposed in heating has resulted in a wider change of ideas than has been the case since convectors were introduced. While convec-

(Continued on page 32)





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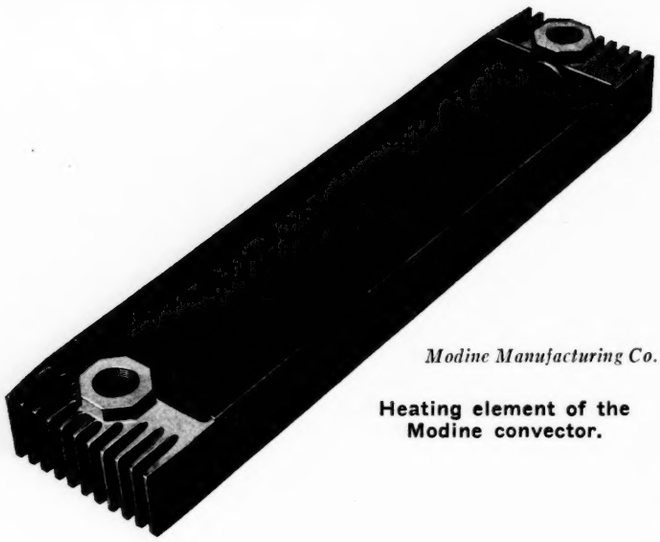
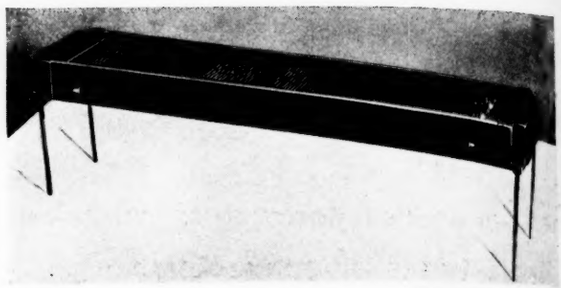


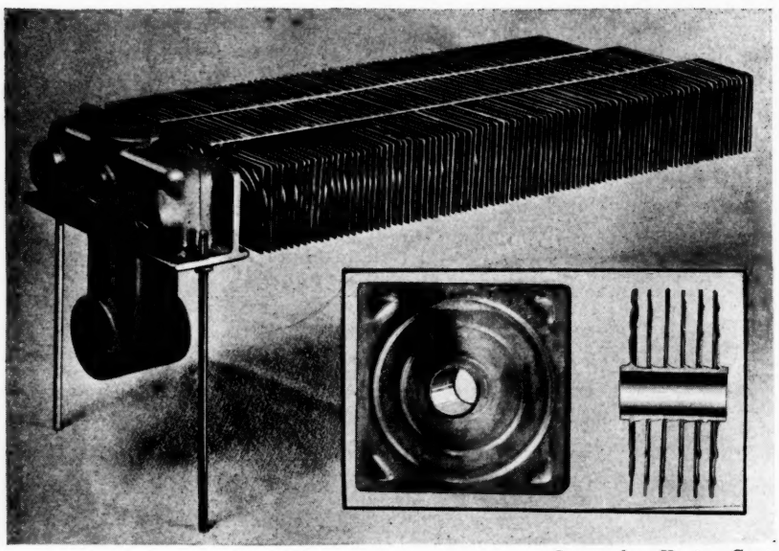
Modine Manufacturing Co.

Heating element of the Modine convector.



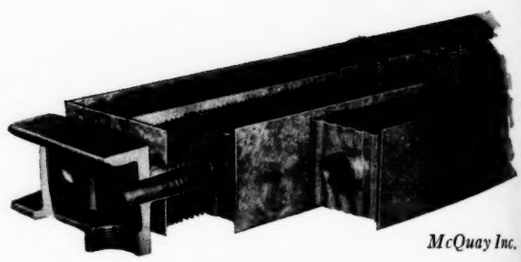
Rome Radiation Co.

A typical Rocop heating element, a convector constructed of copper.



Commodore Heaters Corp.

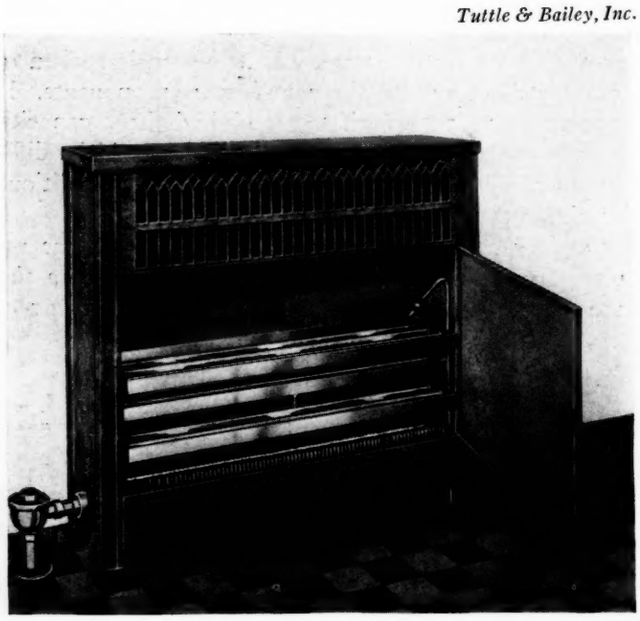
Construction of an element with large one piece headers and copper fins. Fin construction is shown in the inset.



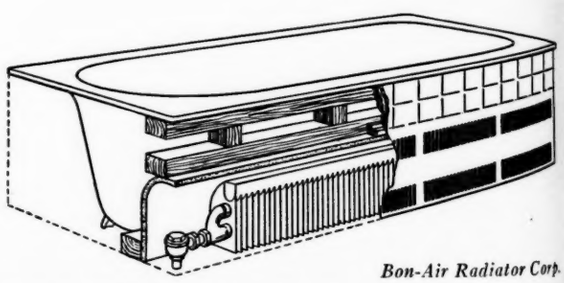
McQuay Inc.

Cut-away section showing construction of heaters and fins of this company's convectors.

Tuttle & Bailey, Inc.



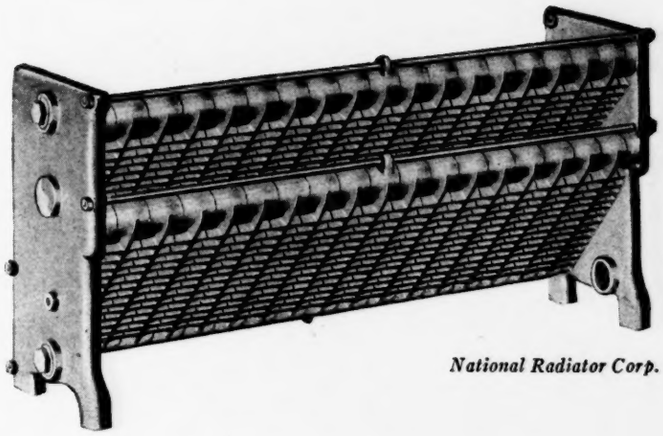
One unit of this company's line is a combination cabinet type humidifier and convector radiator.



Bon-Air Radiator Corp.

A unit so designed that it can be accommodated in unusual positions. It is here shown installed adjacent to a bathtub.

CONVECTORS

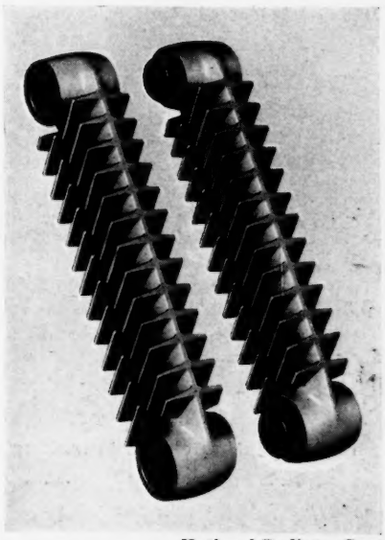


National Radiator Corp.

The Aero convector unit can be assembled in multiple tiers as shown to the right.

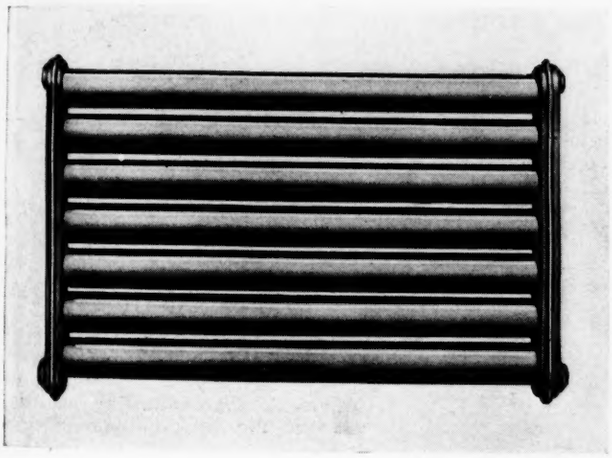
A typical high type Robras convector with supply and return connections.

Rome Radiation Co.



National Radiator Corp.

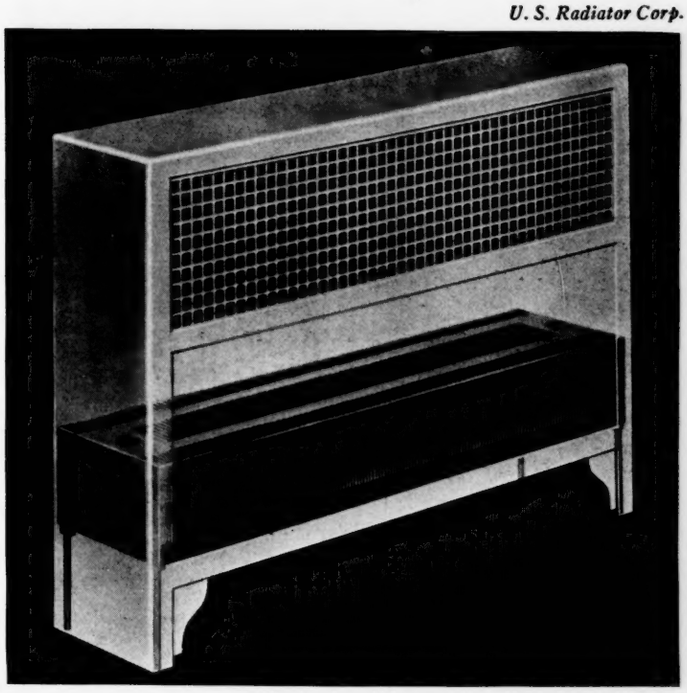
Construction of the elements of the Aero convector. The units are installed at an angle as shown.



Shaw-Perkins Mfg. Co.

A combination convector and radiator resembling a pipe coil and installed exposed. This company also makes a combination type, illustrated last month as type F-2.

U. S. Radiator Corp.



Phantom view showing the Fincast Capitol radiator.

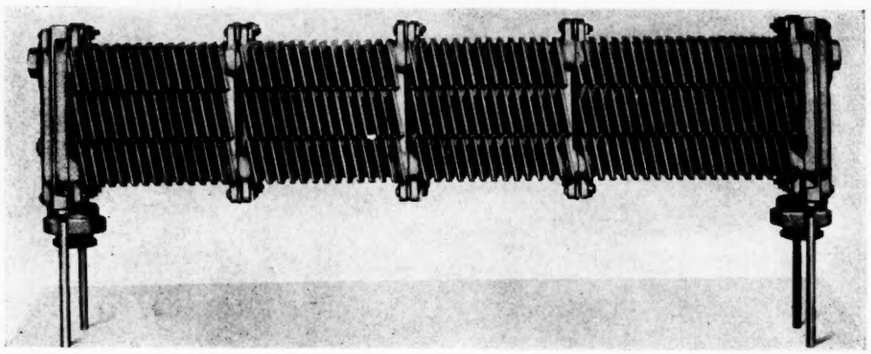
Modine Manufacturing Co.

(Above) Interior of room with Modine copper convector.

Young Radiator Co.

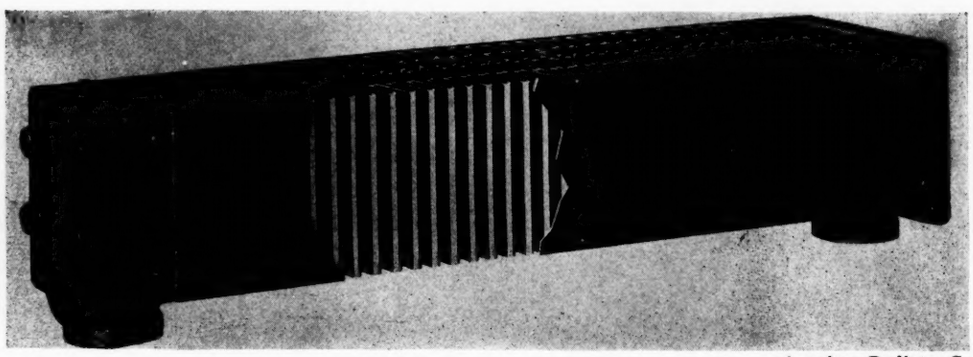
A multiple assembly of a convector heating element.

GRAVITY



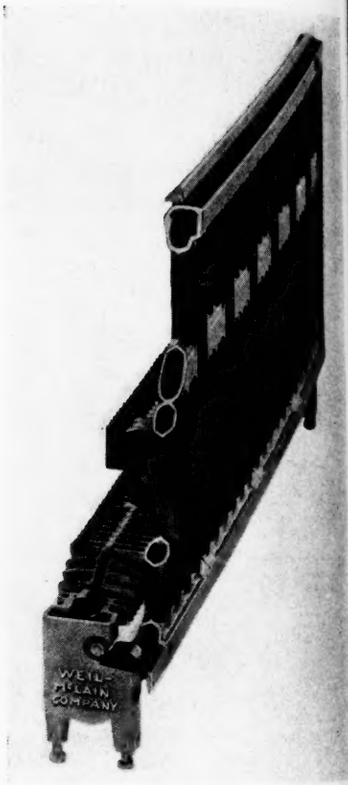
American Radiator Co.

(Above) Assembly of heating elements making up the Arco convector.



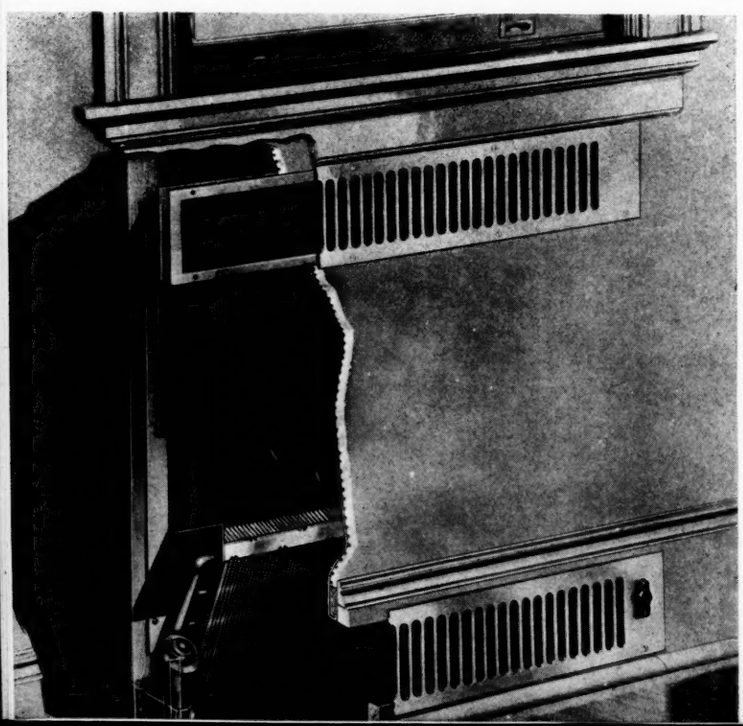
American Radiator Co.

(Above) Construction of a heating element, Murray radiator.



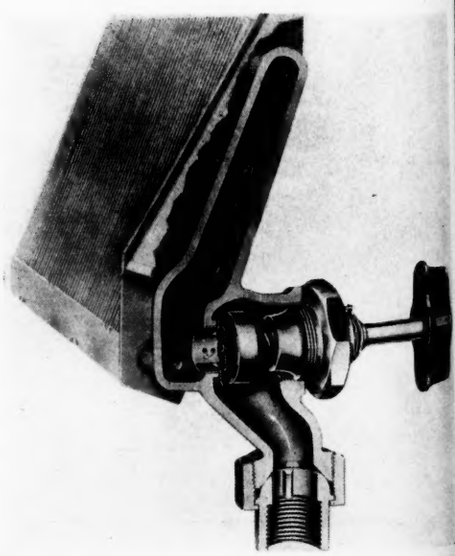
Weil-McLain Co.

Cut-away view showing construction of the Raydiant, combination convector and radiator. This was illustrated last month as type F-1.



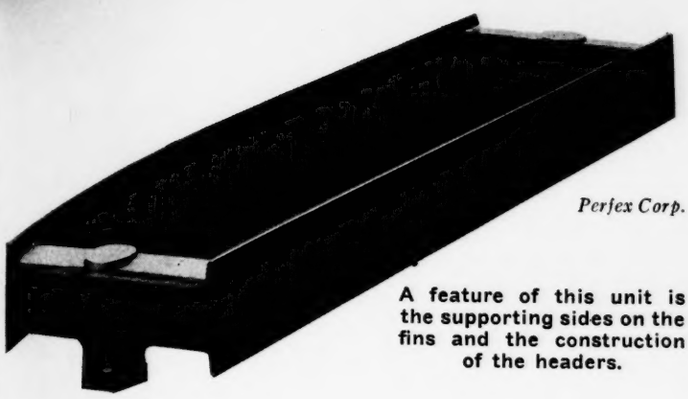
(Right) Cut-away view of an inclined element showing the supply valve and metering orifice.

Warren Webster & Co.



(Left) Note the inclined element, supply valve handle outside the incasement, and support for the element shown.

Warren Webster & Co.



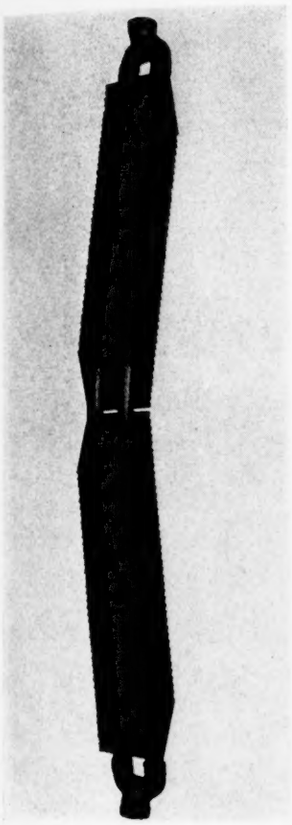
Perfex Corp.

A feature of this unit is the supporting sides on the fins and the construction of the headers.

CONVECTORS

Richmond Radiator Co.

An installation of a Richvar cast-iron combination convector and radiator, illustrated last month as type F-3.



Ilg Electric Ventilating Co.

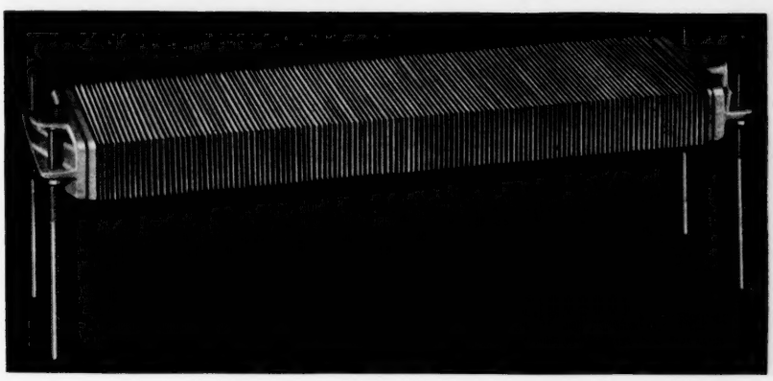
(Left) This Ilg-Columnar element is installed vertically and replaces a section of the riser.

Automatic Florzone Heating Co.

(Above) An unusual type of exposed unit, located along the baseboard.

(Right) A concealed radiator heating element with copper fins.

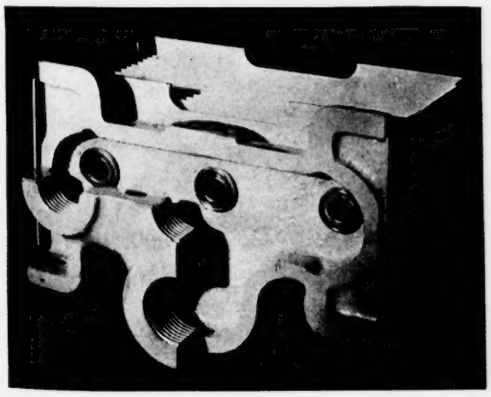
C. A. Dunham Co.



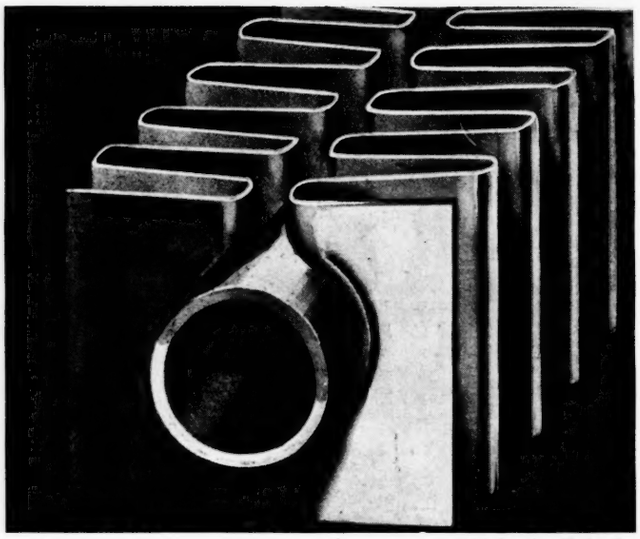
(Below) The Copper-Cast unit, a combination convector and radiator.

Modine Manufacturing Co

(Below) Cut-open section of an element showing heater construction and method of joining tubes to the heater.



The Trane Co.



Wolverine Tube Co.

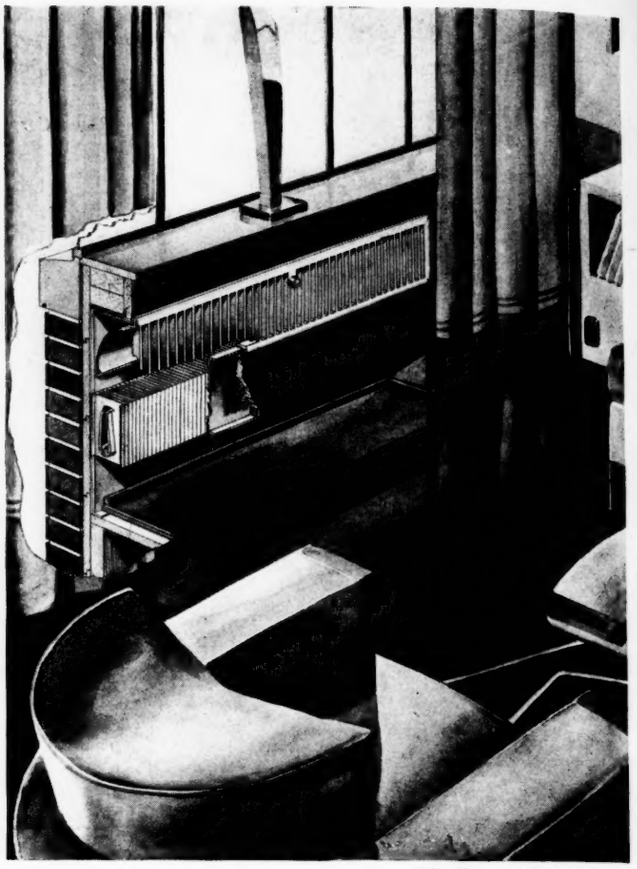
Element of Wolverine convector. Data on this company's unit, not included in last month's classification, follow: Of the general Type D, but extended surface extends over top and bottom as well as sides; Copper tubes with cast bronze headers; Copper extended surface, of sheets bent to form flues; Enclosure fronts, panel or plastered-in; Available in concealed, recessed, semi-recessed, or cabinets; Nine stack heights from 11 to 42 in.; Three depths of elements, 3¼ to 6⅝ in.; 12 element lengths, 16 to 64 in.; Capacities, 11.3 to 148 sq. ft. steam radiator. Unit has multiple oval tubes. Maker also offers bathroom convector.

tors have not as yet made really serious inroads on the direct radiator business, they are no doubt practically responsible for the revolution in our ideas concerning heat distribution in rooms. Experimental work is still under way and some of the conclusions reached have been mentioned. One study, not mentioned so far, but of considerable interest, is that made by Allcut at the University of Toronto.

This investigator paid particular attention to the variables on which the heat output of convectors depend, and his studies supplied answers to a number of pertinent questions. Among these points are the following:

The coefficient of heat transmission varies considerably in concealed radiators, but generally the higher ratios of hot water to steam outputs are obtained with the surfaces that are lightly loaded from a heat transmission standpoint. The output of a concealed radiator varies with the area of the air inlet, which may be too large to give the best efficiency. Other conditions being equal, for commercial purposes the heat output of the concealed radiator is proportional to the length of the heating surface. When heated by water the heat output of a concealed radiator varies as the temperature difference raised to the 1.35 power.

The heat output may be improved in some cases by providing a grille on the air inlet area. The form of the grilles used does not appear to be important, provided the net area is constant. A curved deflector in the top of the stack makes little difference to the heat output. Whether the air inlet and outlet areas are open slots, or provided with grilles, the best proportions are obtained by making the net inlet and outlet areas, respectively, equal to the sectional area of the stack. The best form of stack is that with vertical sides. In-



The Herman Nelson Corp.

Phantom view of an under-the-window installation of the Herman Nelson invisible radiator

creasing the area at the top may reduce the output considerably. When placed under a window, downdraft and consequent inefficiency may be avoided by putting the air outlet in the front of the enclosure instead of at the top.

Spaces must not be left between the ends of the radiator and the enclosure to accommodate piping connections. The enclosure must be a close fit over the radiator. High radiators give better heat output ratios than low ones. The advantage of this is reduced in practice by the smaller heat transmission for every inch added to the height. From an economic standpoint, the low type of radiator is to be preferred.

A Selling Feature

There is one additional point regarding the advantages of convectors that has not been mentioned here. From a sales standpoint, the convector is in a good position in this respect—it is an attractive device to tell building owners about. Although convectors are no longer new to the engineer and contractor, it is surprising how many laymen are unfamiliar with them, and the convector has the advantage of being something different. It is a good device to feature in modernizing and other merchandizing campaigns since, in addition to the technical features outlined previously, it has attractive selling points in being new. The market for convectors is almost unlimited and so far has hardly been touched.

Selecting Motors for Heating and Air Conditioning Equipment

By L. GWATHMEY† and B. S. WEAVER‡

In a previous article the general consideration of motors was discussed and a description given of the various types of motors available. This article took up the general application problem and discussed the specific motor requirements for the various applications.

Fans: In the selection of a fan, the type, size and speed of the fan are determined on the basis of quiet operation and efficiency, taking into account the pressures, length and shape of the ducts, and volume. This practice makes it necessary to select fan motors with considerable care, especially if the volume of air must be variable.

After the full-speed torque has been established for a given fan, adjustable speed torques may be calculated on the assumption that the fan torque varies approximately as the square of the speed. The possibility of extreme overloads is remote and speed reduction below 75% of full load speed is seldom specified.

The ambient conditions vary widely according to the type of fan, the location, and the service for which it is used. Probably the worst condition is the propeller-type fan with the motor mounted in the air stream, the fan being used to exhaust the hot gases from the hood of a stove. Circulating fans for unit heaters are placed ahead of the heating element to prevent passing the heated air directly over the motor. The centrifugal-type fan is common to the centrally located units with duct systems for air delivery.

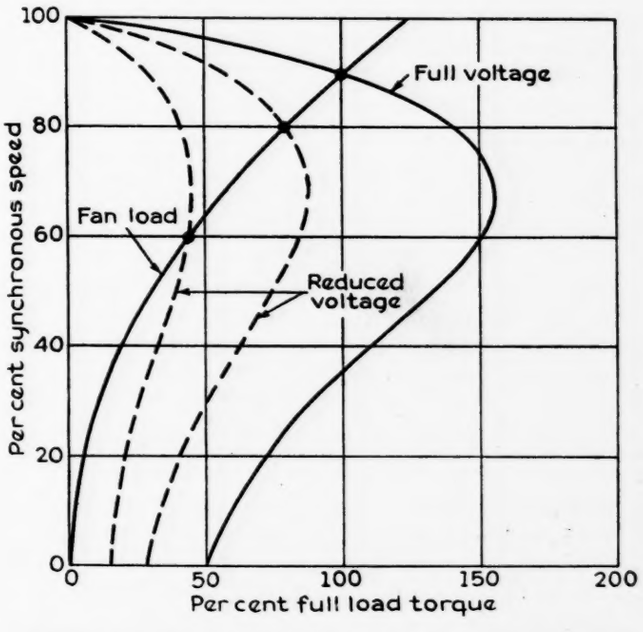
Fan location determines the allowable noise, appearance, and accessibility. It is evident that fans operating in the living quarter should be quieter than those for central plants. However, the latter require care in mounting to prevent transmission of noise through the ducts and framework of the building. Appearance and accessibility are also important.

Where fan motor sizes do not exceed ¼ hp. they are within the range where single phase motors may be supplied. The split phase or capacitor motor may be used depending upon the degree of quietness required. Starting torques of from 40% to 50% for direct connected fans and 100% to 150% for belted applications with maximum torque of from 150% to 200% for both types are sufficient. Constant speed is generally required for automatic operation while adjustable speed is frequently used on manually-controlled devices.

The accompanying graph shows the characteristics of a typical low torque capacitor motor curve designed for fan and blower applications. The high slip at full load is necessary to provide the proper speed regulation by line voltage control. This special design has a wider quiet zone (approximately 50% to 120% of full load) than one of general purpose characteristics. The curve shows further the need for choosing a motor to suit the fan load, since an oversize motor would require greater voltage reduction for a given speed reduction.

The control is comparatively simple. On the smaller sizes, a progressive 3-point snap switch may be used to start the motor on full voltage. After the motor has accelerated, the desired low speed setting may be selected for running conditions. With the transformer method of obtaining reduced voltage, closer speed regulation with varying load is obtained than with the series resistance method. For the larger sizes, full automatic control is available. Low-speed belted fan applications often require a greater amount of break-away torque than that supplied by the low torque capacitor motor. It is advisable to use the high torque type of motor unless the starting and accelerating torques of the fan are definitely shown and fall well within the values available in the low torque type.

The amount of service for which a particular equipment is designed determines whether long annual or short annual service motors should be used. Attic ventilators and exhaust fans running only a few hours



Characteristics of a typical low torque capacitor motor

†Air Conditioning Dept., General Electric Co.
‡Industrial Engineering Dept., General Electric Co.

daily may take advantage of the less expensive short annual service motor, while heater fans in northern climates may be required to run longer than 1000 hr. per year, which is the established dividing line between the two types of service.

In practically all cases flexible mounting is required. Where large, low-speed multivane fans are used for quiet operation, a high-speed motor drive with belt connection is usually used to reduce the cost.

Propeller fans for ventilating use are most frequently mounted directly on the motor shaft and draw air over the motor. Totally enclosed, non-ventilated motors are preferred, since open motors would collect a considerable amount of dirt. It is possible to use the same frame size as the open motor for a given rating on account of the motor being in the air stream.

Refrigerating Compressors: Selection of motors for compressor service involves many considerations, since there is a wide variety of compressor designs with differing motor requirements.[1] Some of the many points involved are:

Will the motor be hermetically sealed-in or will it be external to the compressor?

If sealed-in, what is the action of the refrigerant on the windings and insulation?

If external, what method of coupling and mounting will be provided?

What overload will be imposed on the motor during the pull-down period?

What control will be used?

What starting torques are required and is an unloader desirable?

In the hermetically-sealed unit, the materials used for windings and for insulation must be such as to avoid chemical reaction with the refrigerant. Excessive motor heating and residual moisture increase the tendency toward chemical reaction. Interchangeable single and polyphase motor mounting dimensions will be a necessity. Where the motor is not hermetically sealed in the compressor, the problems of coupling, mounting, and quietness are encountered.

Power required by a compressor may be fixed by establishing definite suction and discharge pressures, but will vary under different atmospheric conditions by possibly 15% to 20%. Overload during the pull-down period may be extremely high, causing the motor with insufficient maximum torque to stall; or of sufficiently long duration to take the motor off the line through the operation of the temperature overload relay.

Compressor starting torque requirements, depending upon the number of cylinders, may be as high as 200%-250% of full load running torque for starting under compression. This requires the use of a high starting torque, low inrush motor, thrown directly across the line. An unloading device is preferable where higher starting torques are involved (a single cylinder compressor requires 350%-400% starting torque) and may be found on units with lower starting requirements. Where an unloader is used, the starting torque requirements may be less than normal full load running torque, permitting the use of more efficient motors. In general, motors with 225% to 250% starting torque and 200% to 225% maximum torque will meet the demand for starting under compression and carrying through the pull-down period.

Oil Burners: Oil burner motors operate mechanisms to supply oil in suitable form to a combustion chamber and to supply air for combustion. For domestic units, the motor sizes are generally between 1/20 hp. and 1/6 hp. Although the starting and overload torque requirements are not severe, the motor must be selected to operate positively at the lowest voltage which may reasonably be expected on a domestic circuit of nominally 110 or 115 volts, and must be within safe limits as to heating at 125 volts. Split-phase motors are commonly used, and are designed to reduce magnetic hoist to a low level. Since the motor usually becomes an integral part of the burner mechanism, the changeover from starting to running connections is sometimes made by external control rather than by a centrifugal switch on the motor shaft.

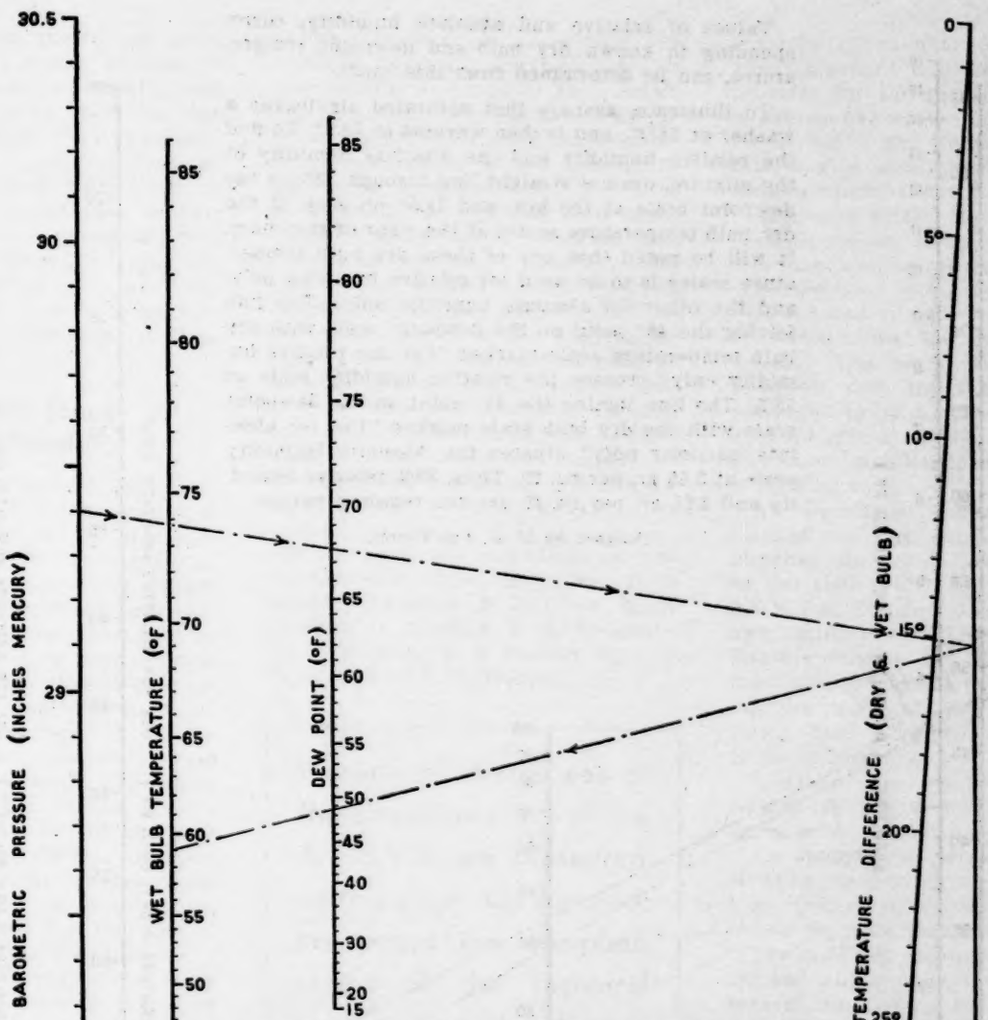
Stokers: Application of stoker motors is generally similar to that of oil burner motors. The ratings vary from 1/8 hp. to 1/4 hp., since the motor is generally required to drive through gears a coal feed or grate mechanism, and sometimes an ash conveyor. As a rule, the motor runs at constant speed, the operation being intermittent. The split-phase motors used for these drives are totally enclosed for protection. Although the momentary overloads involved in handling coal and ash are high, motors of standard characteristics (starting torque 175%, maximum running torque over 200%) may be used. Since the motor torque is multiplied many-fold by gear reductions of the order of three to five thousand to one ratio, it is undesirable to have the motor exert its maximum torque on the mechanism; hence the drive usually includes a slip clutch or shear pin which will give way at a load somewhat below the maximum torque which the motor can supply.

Pumps: Many hot water heating systems now use low-head centrifugal pumps to provide forced circulation for quick response. Cooling systems may also utilize pumps for circulating either condenser cooling water or a heat exchanging liquid between evaporator and air cooler. These applications require a quiet motor, flexibly coupled to the pump, and may require that the motor be flexibly supported, since any vibration is easily transmitted through the piping. In the smaller sizes, as used with domestic heating systems, split-phase motors of 1/8 hp. to 1/4 hp. are used. For cooling-water pumps similar motors are used. However, if the cooling plant is large enough to require a pump motor of 1/2 hp. or 3/4 hp., and to utilize a polyphase compressor motor, the pump motor will generally be specified as a polyphase motor to operate from the same supply.

In the concluding article of this series, which will appear next month, the authors will discuss such problems affecting motor selection as radio interference, direct current, and noise.

[1]Close cooperation between the compressor manufacturer and the electrical manufacturer supplying the motors results in a more satisfactory installation than can be obtained without this cooperation.

DEWPOINT TEMPERATURES



Wet and dry bulb temperatures being known, this chart may be used to determine the corresponding dewpoint temperature at any barometric pressure. The following example demonstrates its use:

What is the dewpoint temperature when the wet and dry bulb temperatures are respectively 59°F. and 74.1°, with the barometer at 29.4 in. of mercury? Extend a straight line from 29.4° on the barometric pressure scale at the extreme left through 15.1° (the difference between 74.1° and 59°), on the temperature difference scale at the right, intersecting the vertical index at the extreme right. From this point of intersection, extend a second straight line back to 59° on the wet bulb temperature scale. Read 48.3°, the required dewpoint temperature, at the intersection of this line with the dewpoint scale.

Designed by M. G. Van Voorhis

Published by Heating and Ventilating, 148 Lafayette St., New York

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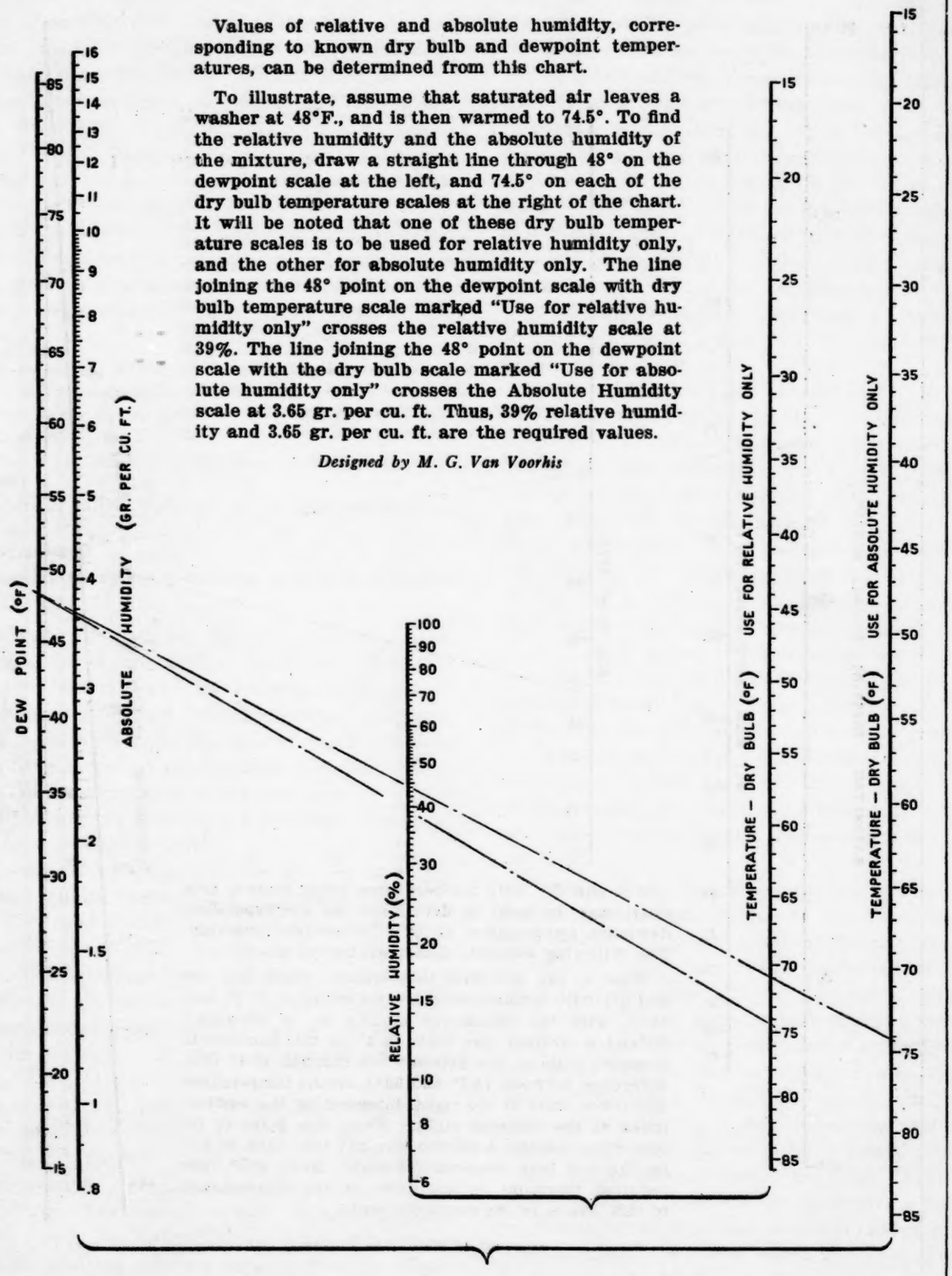
H & V's REFERENCE DATA—29

RELATIVE AND ABSOLUTE HUMIDITIES

Values of relative and absolute humidity, corresponding to known dry bulb and dewpoint temperatures, can be determined from this chart.

To illustrate, assume that saturated air leaves a washer at 48°F., and is then warmed to 74.5°. To find the relative humidity and the absolute humidity of the mixture, draw a straight line through 48° on the dewpoint scale at the left, and 74.5° on each of the dry bulb temperature scales at the right of the chart. It will be noted that one of these dry bulb temperature scales is to be used for relative humidity only, and the other for absolute humidity only. The line joining the 48° point on the dewpoint scale with dry bulb temperature scale marked "Use for relative humidity only" crosses the relative humidity scale at 39%. The line joining the 48° point on the dewpoint scale with the dry bulb scale marked "Use for absolute humidity only" crosses the Absolute Humidity scale at 3.65 gr. per cu. ft. Thus, 39% relative humidity and 3.65 gr. per cu. ft. are the required values.

Designed by M. G. Van Voorhis


DEW POINT (°F)
ABSOLUTE HUMIDITY (GR. PER CU. FT.)
RELATIVE HUMIDITY (%)
TEMPERATURE – DRY BULB (°F) USE FOR RELATIVE HUMIDITY ONLY
TEMPERATURE – DRY BULB (°F) USE FOR ABSOLUTE HUMIDITY ONLY

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H & V's REFERENCE DATA—30

Heating Engineers Hold Fortieth Annual Meeting in New York

Over 500 members, guests, and ladies attended the 40th annual meeting of the American Society of Heating and Ventilating Engineers, held at the Hotel Biltmore, New York, February 5-9. There was a large attendance at the technical meetings, particularly at sessions where small building heating and conditioning were discussed. The entertainment features, including the dinner-dance February 5, and the banquet February 7, were quite successful with good attendance and enjoyable music.

President Jones Opens Meeting

The sessions were opened February 5 by President W. T. Jones, following which Arthur Ritter, general chairman of the committee on arrangements, welcomed the members and guests. President Jones responded and presented a report covering the activities of the Society during his year in office, in which he reported that local chapters may soon be established in Washington and San Francisco.

A. V. Hutchinson, secretary, read the report of the Council, and stated that the membership of the Society now numbers 1887. During the year the Council approved the establishment of a student chapter at Carnegie Tech, revised the advertising rates of the *Guide*, and approved the selection of New York city for the 40th meeting.

In his annual report, Secretary Hutchinson thanked the members of the headquarters staff for their loyal cooperation during the year.

Haynes New President

The report of the tellers of the election was read by M. E. Durkee, who announced that the following officers had been elected: president, C. V. Haynes; first vice-president, John Howatt; second vice-president, G. L. Larson; treasurer, D. S. Boyden.

The report of the finance committee was presented February 6 by Chairman John Howatt, and showed that the finances of the Society were in good shape.

Prof. G. L. Larson, chairman of the committee on research, presented the report of that committee. Among the new cooperating institutions in the research program are Case School of Applied Science and Michigan College of Mining and Technology.

Among the new research projects is one on Heat Requirements of Buildings. This committee was appointed during the year to coordinate and reconcile the many available data on heat transfer and loss, or gain, resulting from laboratory studies, with the actual formulae for using such values in the calculation of the heating requirements of a building. The work of the committee is a final step in the Society's program of studying heat losses from buildings. Plans are being outlined for studies in Detroit, Pittsburgh, Minneapolis, Madison, Urbana, and other places, of the relation between calculated and actual heat requirements of buildings. At least some of these studies will include an accurate study of the hourly heat requirements to maintain desired temperature in individual rooms on different exposures and different elevations of modern buildings.

Members of the committee on heat requirements of buildings are: D. S. Boyden, chairman, P. D. Close, W. H. Driscoll, H. M. Hart, P. E. Holcombe, V. W. Hunter, F. B. Rowley, R. J. J. Tennant, and J. H. Walker.

Reports of committees at the annual meeting of the A.S.H.V.E. are presented on this page. On succeeding pages the complete report of the technical sessions and the exposition appear.

W. L. Fleisher presented the report of the committee on nomenclature at the afternoon session, February 8. Consideration was given to the matter of rescinding the action taken by the society last summer when it adopted the term "mBh" as the abbreviation for "thousand B.t u. per hour." It was later decided, however, that no action would be taken at this meeting and the committee will go further into the matter and report at the next meeting.

Pump Code Modified

John Howatt, chairman of the committee in charge of the preparation of a standard code for testing and rating vacuum heating pumps, presented the proposed code, the object of which is to provide a standard method of testing and rating the air and water capacity of vacuum heating pumps under standard conditions. The code provides for the rating of the pump in gallons per minute maximum capacity at 160°. Mr. Howatt stated that this was a compromise among the manufacturers and the committee.

According to Mr. Howatt, there has been confusion among engineers in selecting vacuum pumps due to disagreements on ratings, and a need for such a standard code was felt in 1932, at which time the committee was formed. The work was undertaken seriously early in 1933, the code as presented being a compromise acceptable in general to the manufacturers who have simultaneously established a parallel code.

An amendment offered by C. V. Haynes was adopted and provided for inserting the word "low" in the title of the code which as adopted reads A.S.H.V.E. Standard Code for Testing and Rating Return Line Low Vacuum Heating Pumps. Mr. Haynes' amendment also provided for definitely limiting the scope of the code to those which have a return vacuum up to 10 in. of mercury.

A minor amendment was offered in respect to the motor efficiencies to agree with A.I.E.E. standards.

An amendment, proposed by F. D. Mensing, to provide for a test run of 1 hr. instead of a 20-min. run called for by the code, failed to pass.

The code was approved by the meeting and will be submitted to the members of the Society by letter-ballot.

C. V. Haynes offered a motion that the committee be retained to prepare a code for vacuum heating pumps where the return vacuum is greater than 10 in. of mercury. The motion carried.

Corrosion Tests Started

A progress report on "Corrosion Studies in Steam Heating Systems," being carried on at Michigan College of Mining and Technology in cooperation with the A.S.H.V.E. Research Laboratory, was presented by Prof. R. R. Seeber, co-author with Prof. F. A. Rohrman and G. E. Smedberg. The subject was introduced by J. H. Walker who pointed out that while corrosion is due to O_2, CO_2, or both, little is known about the quantities which cause corrosion. Consequently, work has been started at Michigan College. The paper described the apparatus set up for the studies. Professor Seeber requested criticisms and suggestions of the set-up and methods of tests.

Sun Radiation and Psychrometry—Subjects of Important Papers

STUDIES on solar radiation, with particular reference to its transmission through glass windows and its ultimate effect on the air conditioning load, were outstanding papers on subjects other than those dealing with house-heating and the relation of health to air conditioning. In addition, a paper resulting from a study of weather records proved intensely interesting to the members attending the technical sessions.

What Outside Temperature to Use

Paul D. Close presented a paper on "Selecting Temperatures and Wind Velocities for Calculating Heat Losses," an analytical attempt to determine whether heating systems should be designed for the coldest day, the day of highest wind velocity, or, if neither of these, which combination of low temperature and wind velocity should be used.

Transmission losses depend upon the temperature head, and to a minor extent (except in the case of highly conductive walls) upon the wind velocity; infiltration losses depend upon both the temperature head and the wind velocity. Since the proportions of transmission and infiltration losses to the total vary with the type of construction and temperature and wind conditions, there is no general correlation between temperature and wind velocity for calculating heat losses.

For any given room or space, some concurring combination of temperature and wind velocity will result in a heat loss equal to or greater than other combinations.

The temperature-wind velocity condition to be selected for calculating the heat losses varies with the type of construction, and for any individual case may be determined from an analysis of local weather conditions.

According to Mr. Close, it is probable that temperature-wind velocity combinations for design purposes may be readily ascertained for each locality and for one or more common types of construction, with particular reference to the approximate ratio of the infiltration loss to the total loss.

In most cases, solar radiation should be neglected since the maximum heat loss usually occurs in the early morning hours when the sun is not shining.

Prof. A. C. Willard pointed out in the discussion that although the paper was not new it was highly valuable in that it brought together for the consideration of Society members the need for correlating scientific data to bear on the subject of actual heat loss.

W. L. Fleisher commented on the paper by saying that in subjects of this kind it was dangerous to assume too much from a theoretical standpoint, and as an example pointed out that one contractor organization had run tests on a building and found that instead of the building having the greatest heat requirements at the side of the building facing the wind, more heat was needed at the leeward side of the building. Mr. Fleisher ventured the opinion that possibly one solution of the problem of under-radiation would be to put a small amount of radiator surface in a building equipped with fans which could be used on cold days to force air over the surface to obtain extra capacity.

One of the papers from the Society's research laboratory was "Radiation of Energy Through Glass," by J. L. Blackshaw and F. C. Houghten, presented by Mr. Blackshaw. This paper reported on tests made at Pittsburgh with a pyrheliometer. The conclusions were to the effect that glass does not transmit low temperature radiation. However, ordinary double-strength window glass transmits 6% and 12.3% of the total radiation from surfaces from 700° and 1000°, respectively.

In commenting on the paper, R. A. Miller said that the test curves shown in the paper, which showed that changing the angle of incidence of the radiation rays had the same effect as increasing the thickness of the glass, with curves closely parallel, was to be expected, since changing the angle had, in effect, changed the thickness of the glass.

Measuring Solar Radiation through Windows

Further studies on sun heat were reported in the Society's research paper "Studies of Solar Radiation Through Bare and Shaded Windows," by F. C. Houghten, Carl Gutberlet, and J. L. Blackshaw, presented by Mr. Houghten. Tests were run with different kinds of shades in standard finishes and also with aluminum finishes. With an ordinary buff shade, half drawn, only 68% of the total solar energy is transmitted, whereas with a standard buff shade fully drawn 45% of the total energy was transmitted. Venetian blinds with aluminum finish placed on the outside of the window had an 8% transmission, while complete shading reduced the energy transferred to 5% of the total.

Conclusions reached by the authors were:

An analysis of the sources of heat gain through a window is made. Calculated heat gains are compared with measured rates of heat removal for bare windows, for completely shaded windows, and for windows with several types of shading appurtenances applied in different ways.

Energy transfers through shaded windows are compared with the energy transferred through a bare window. Results showed that 5% of the solar radiation through a bare window was transferred through a completely shaded window, 22% through an outside Venetian blind, 28% through an awning, 45% through an inside shade, and 58% through an inside Venetian blind. Similar percentage transfers are also given for other variations in both kind of finish and application of these appurtenances.

Goff Has Paper on Thermodynamics

Prof. A. P. Kratz presented "Thermodynamic Properties of Moist Air," by John A. Goff, who was unable to be present.

The heating and ventilating engineer already possesses sufficient information, mostly in the form of psychrometric charts, to enable him to deal effectively with most problems in his field involving properties of atmospheric air. This being true, it may appear quite unnecessary to attempt a further contribution to the subject. Still, much of this information, although capable of yielding approximate results of practical value, is, in some cases, strictly speaking, incorrect and sometimes leads to impossible conclusions if used without discretion. Consequently, an attempt to work out a thermodynamically consistent treatment of the properties of atmospheric air based on best available thermal data, written in the language of thermodynamics, but yet reduced to a form which admits of quick and easy application, may possibly find favor with even the more practical-minded engineer. Professor Goff's paper is such an attempt.

The paper was discussed by Dr. A. A. Adler, W. L. Fleisher, and others, one of whom suggested that while the paper was a very nice presentation based on existing data, nevertheless there is a need for further refinements in instruments for measuring wet bulb temperatures.

Residential Heating and Air Conditioning Studied from All Angles

THE number of papers on the various phases of house-heating and conditioning made this subject an outstanding one at the A.S.H.V.E. meetings. Particularly important were the results on furnace operation and control and the studies made on cooling by use of attic fans.

Summer Cooling for Houses

S. Konzo presented a paper prepared by him and A. P. Kratz, "Study of Summer Cooling in the Research Residence for the Summer of 1933,"[1] the paper being the result of research conducted at the University of Illinois in cooperation with the N.W.A.H. & A.C.A. and the A.S.H.V.E. Research Laboratory.

The authors found that the circulation of air from the outdoors at night, when used as a supplement to artificial cooling during the day, has considerable merit in reducing the seasonal cooling load that would otherwise be required. Circulation of air from the outdoors at night may make the use of artificial cooling unnecessary for a considerable portion of the summer season.

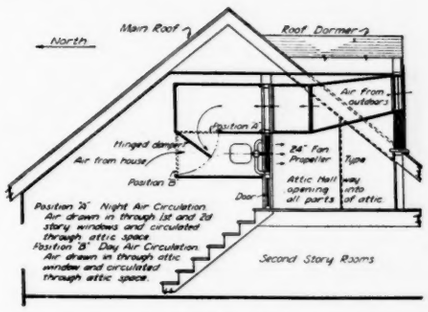
If the best means of circulating air from the outdoors at night had been used at the research residence during the summer of 1932 the ice meltage could probably have been reduced from the 43 tons actually used to an amount of the order of 10 tons.

The practice of partly opening a few windows at night is not very effective as a means of circulating air from the outdoors, according to Mr. Konzo.

Use of a fan in a forced air heating system to circulate from 6 to 9 air changes per hour from the outdoors at night is much more effective than opening a few windows even when the same amount of window opening is retained for the two cases.

Use of a fan in a forced air heating system to circulate 9 air changes per hour is more effective if all of the windows and the attic door or hatchway is opened than if only a few windows are opened.

The most effective method of circulating air from the outdoors at night is to open all of the windows and to use an attic fan drawing the equivalent of approximately 17 air changes per hour into the windows of the first and second stories and discharging it into the attic to escape from the attic windows.

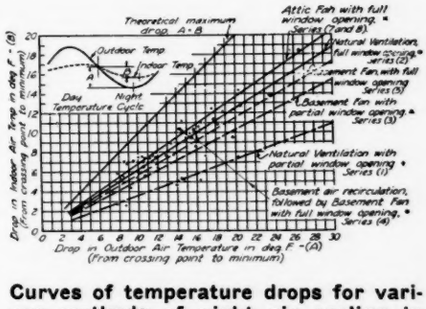

North
Main Roof
Roof Dormer
Air from outdoor
Position A
Hinged damper
Air from house
Position B
24" Fan Propeller Type
Attic Hallway opening into all parts of attic
Door
Position "A" Night Air Circulation. Air drawn in through 1st and 2d story windows and circulated through attic space.
Position "B" Day Air Circulation. Air drawn in through attic window and circulated through attic space.
Second Story Rooms

Arrangement of attic fan in Research Residence

In the case of a two-story house similar to the research residence having an ample attic with dormer windows and large attic door, opening all of the windows and the attic door is nearly as effective for circulating air from the outdoors at night as the use of an attic fan producing approximately 17 air changes per hour.

Prof. G. L. Larson presented M. K. Drewry's paper "Low-Cost Air Conditioning for a Small Residence." This paper described a modification of a warm-air system for hot water air heating, tap water cooling, automatic fuel feed, and year-'round filtration and humidity control. Among the points of interest in the results obtained in this residence, which is Mr. Drewry's home, are: 90% average boiler efficiency; $6 per summer tap-water cooling; year-'round coke fire; 10% CO_2 average from coke fire; 160° average flue gas temperature; 70 watts input for supplementary mechanical air circulation, and satisfactory stoking by gravity of small-size fuel from a simple welded hopper. Total investment and annual operating costs, including cooling, were found to be no greater than those of the previous simple heating system.

According to Mr. Drewry, the data collected from his installation show that satisfactory year-'round air conditioning can be practiced under the particular existing conditions in Milwaukee at no greater total operating and investment cost than simple warm-air heating. High boiler efficiency, low cooling cost, and moderate equipment costs make this result possible.


Theoretical maximum drop, A-B
Attic Fan with full window opening. Series (7) and (6)
Natural Ventilation, full window opening Series (2)
Basement Fan with full window opening Series (5)
Basement Fan with partial window opening Series (3)
Natural Ventilation with partial window opening Series (1)
Basement air recirculation, followed by Basement Fan with full window opening. Series (4)
Outdoor Temp
Indoor Temp
Day
Night
Temperature Cycle
Drop in Indoor Air Temp in deg. F. - (B) (From crossing point to minimum)
Drop in Outdoor Air Temperature in deg. F. - (A) (From crossing point to minimum)

Curves of temperature drops for various methods of night air cooling in Research Residence

Furnace Controls

A. F. Hubbard, co-author with S. Konzo, presented a paper entitled "Automatic Controls for Forced-Air Heating Systems," describing investigations carried on at the Engineering Experiment Station of the University of Illinois in cooperation with the National Warm Air Heating and Air Conditioning Association.

The principal objects of this study were to determine what particular features are essential to a good control system and to compare the performance characteristics of several different types of control systems and to classify the systems from the viewpoint of satisfactory performance.

The paper covered hand-fired, coal-burning furnace plants only. The methods of control were of four different arrangements, as follows:

Type I: Automatic control of furnace damper operation only, with the fan operating continuously and independently of any control.

Type II: Automatic control of both the fan operation and the furnace damper operation; so that the fan operated intermittently, and the damper-open periods occurred irrespective of whether or not the fan was running.

Type III: Automatic control of both the fan operation and the furnace damper operation; so that the fan operated intermittently, except during the damper-open periods when it was rendered totally inoperative.

Type IV: Automatic control of both the fan operation and the furnace damper operation; so that the fan operated intermittently, and the damper-open periods accompanied either all, or some fraction of each of the fan-on periods.

Control Type I had many merits, and in some cases, particularly in large installations, the advantages of continuous fan operation far outweigh the disadvantages. Four suggestions were offered which would overcome to some extent the chief disadvantages of high cost of continuous fan operation and of low register air temperatures in mild weather. The suggestions were:

(1) By using suitable diverters in the register outlets, thus tending to spread the air stream and reduce the

[1]This paper was also presented by Mr. Konzo at a meeting of the Illinois Association of Ice Industries, January 23.

velocity, or by using high sidewall registers, the flow of air from the registers may be made unobjectionable even for low air temperatures at the register outlet.

(2) By providing for an auxiliary fan thermostat in the furnace bonnet, the fan may be stopped when the bonnet air temperature becomes objectionably low.

(3) By suitable design, the plant may be made to operate on register air temperatures of from 160° to 175° instead of the 135° now commonly used, thus permitting the use of a fan with smaller air capacity.

(4) By using a two-speed drive on the fan motor, the fan speeds can be regulated to maintain a more uniform register air temperature for all heating loads. The low speed drive would be used for possibly four-fifths of the heating season, and the high speed drive for extremely cold weather only.

With continuous fan operation, satisfactory performance was obtained by means of the simple control equipment commonly used in gravity installations —a room thermostat and a damper motor. With intermittent fan operation, however, the minimum of equipment that could be used included a bonnet thermostat in addition to the room thermostat and damper motor. This minimum of equipment was used in the case of control Type II and the results obtained were not satisfactory, as indicated in the foregoing discussion.

The results obtained with controls Type III and Type IV, on the other hand, showed that satisfactory conditions may be maintained in the house with the intermittent fan operation provided that a fan relay switch is incorporated in the control system so that the fan operation may be governed by the room thermostat. The partly satisfactory results obtained with control Type III showed that with this combination, frequent adjustment of the bonnet thermostat was necessary to prevent temperature over-runs. Control Type III had one advantage over control Type IV in that when sudden demands were made on the plant, the combustion rate was successfully limited. This advantage, however, was offset by the fact that throughout each pick-up period the fan was totally inoperative, and as a consequence the room temperature fell below normal during these periods.

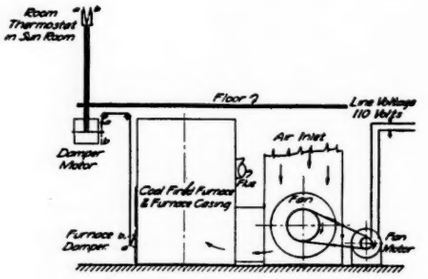
The very satisfactory results obtained with control Type IV showed that it was adaptable to normal operation over a wide range of weather conditions without changes in the initial adjustment. Also, the combustion rate could be successfully limited at all times by the addition of a stack limit thermostat, although it did not become excessively high even without the use of a stack limit. The results obtained with the use of control Type IV showed that it was possible to obtain results with intermittent fan operation that were as equally satisfactory as those obtained with continuous fan operation without involving the high operating costs characteristic of the latter arrangement.

The authors drew the following conclusions as applicable to the conditions under which the tests were conducted:

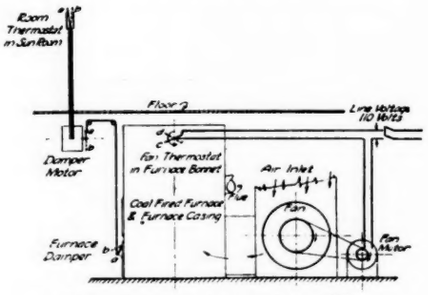
The room air temperature may best be maintained within definite limits by operating the fan from the room thermostat (through a fan relay).

For ideal operation, the operating range of bonnet air temperatures should be governed either manually or automatically, to correspond to the heating demands. A system which tends to maintain a fixed range of bonnet air temperature may be in adjustment to give equal temperatures in the different rooms for a fairly wide range of weather conditions, but for extreme weather conditions this adjustment may result in unequal temperatures in the different rooms.

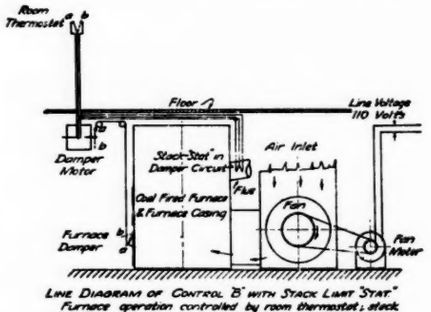
The most satisfactory operation of the heating plant required the maintenance of a uniform combustion rate just sufficient to supply the heating demands being made on the furnace. This requirement involves frequent openings and closings of the furnace damper,



LINE DIAGRAM OF CONTROL SYSTEM "B"
Furnace operation controlled by room thermostat.
Fan operating continuously during 24 hr test period



LINE DIAGRAM OF CONTROL SYSTEM "A"
Furnace operation controlled by room thermostat.
Fan operation controlled by fan thermost in bonnet



LINE DIAGRAM OF CONTROL "B" WITH STACK LIMIT "STAT"
Furnace operation controlled by room thermostat; stack "stat" limits flue gas temp rise. Fan operating continuously.

Three of the furnace control arrangements tested in Research Residence

and can best be fulfilled when the damper operation is dependent on both the room temperature and the bonnet air temperature. This is equally true for gravity and forced air systems.

In systems using intermittent fan operation, uniformity in the length of the cyclical periods of the fan is necessary in order to maintain equal temperatures in the different rooms. Excessively long periods of either fan operation or gravity operation may cause over-heating in some sections of the house apart from the control room.

With control systems involving intermittent operation of the fan, the fan should be started between four and eight times per hour in order to obtain satisfactory regulation and equalization of temperatures in the different rooms.

Continuous operation of the fan has many advantages, particularly in large installations.

Total power required in the case of intermittent fan operation varies from 10% to 100% of the power required for continuous fan operation. In the case of intermittent operation, the power required to start the fan contributes an additional load varying from 3% to 27% in excess of the normal running load, over a range of indoor-outdoor temperature differences of from 20° to 60°.

Fuel consumption and over-all house efficiency for intermittent fan operation and continuous fan operation are practically the same.

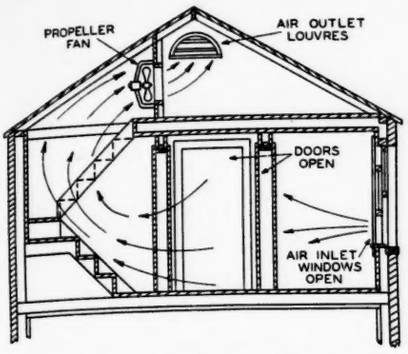
A stack limit thermostat arranged to prevent flue gas temperatures from exceeding a predetermined upper limit can be successfully used to limit the combustion rate during sudden load demands.

Attic Fans Keep Houses Cool

A paper reporting results collected from tests conducted by the Detroit Edison Company, "Comfort Cooling with Attic Ventilating Fans," by G. B. Helmrich and G. H. Tuttle, was presented by Mr. Helmrich. The tests were run for the purpose of showing that attic ventilating fans can be used to maintain comfortable conditions during a large part of the summer months. However, such fans were not intended to replace mechanical cooling systems for the hottest days.

Installations made in the Detroit residence were of three distinct types. One was a standard commercial propeller fan, the second a centrifugal multi-blade fan, and the third a centrifugal, steel plate, curved blade fan, installed without a scroll. The essential requirements for cooling systems of this kind are quietness of operation and low first cost. Fan efficiency is unimportant because of the comparatively short season of use.

The three types of installations included: Centrifugal Fan: A multi-blade centrifugal fan was installed in the attic space of an eight-room house of brick and stucco construction. The



Attic cooling with propeller fan in stairwell

suction side of the fan was connected to exhaust ducts leading to grilles placed in the ceilings of two bedrooms, the air being drawn through the open bedroom windows and discharged into the attic space where it flowed to the outdoors through louvers placed in the gables.

Propeller Fan: A 10-blade propeller fan of the disc type was installed at the head of the attic stairway of a six-room house of ordinary frame construction. The fan was mounted over the attic stairwell in such a manner that the entire attic stairway is placed under suction. The air is drawn through the open windows of the three bedrooms into a central hallway, and thence up the attic stairs where it is discharged into the attic space and allowed to find its way to the outdoors through open windows placed at either end of the attic.

Centrifugal Steel Plate Fan: In an endeavor to avoid some of the noise experienced with propeller fans, and at the same time overcome the obstacle of higher installation costs which are inherent in a system requiring ductwork connected to a centrifugal fan, a rather unique fan assembly was devised. This assembly consists of a single inlet, backward curved blade, steel plate type, centrifugal fan wheel, mounted on a light angle iron frame which supports the fan wheel, shaft, two bearings, V-belt drive, and motor. No fan scroll was used and the inlet was placed close to a circular opening cut in a plaster board partition which served to divide a small attic space into a suction and discharge chamber. As in the case of the propeller fan installation, air is drawn up the attic stairway, into the fan wheel, and discharged freely from the blades into a small attic space, from whence it flows through open attic windows to the outdoors.

According to Mr. Helmrich, it is quite practicable, by the use of either a centrifugal or propeller type attic ventilating fan, to effectively cool the sleeping rooms in a moderate-sized house.

The downstairs portion of the house can be effectively ventilated if the fan is connected to an attic stairway in such a manner that the entire first floor can be placed under suction by way of the first floor stairs. It is not advisable, however, to leave the downstairs open after the occupants of the house have retired, as the flow of air through the bedrooms, and consequently the cooling effect in these rooms, is greatly reduced.

Wherever possible, the capacity of the fan should be such as to provide a minimum of about 30 air changes per hour. In very large homes, physical or commercial limitations may dictate the use of a proportionately smaller fan, providing about 20 changes of air per hour. This is still sufficiently high to accomplish reasonably satisfactory cooling.

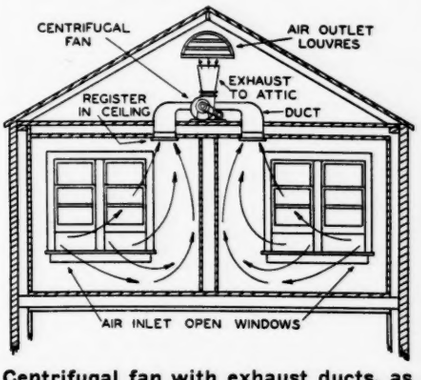
Natural ventilation, induced by the stack effect of the structure resulting from the opening of attic doors and windows, is not nearly as effective in circulating air from out of doors as is an attic fan which provides about 30 changes of air per hour.

The authors concluded that, in the light of the past summer's experience, attic fan ventilation for residences should prove to be a satisfactory substitute for artificial cooling during a large part of the summer season under climatic conditions similar to those in Detroit.

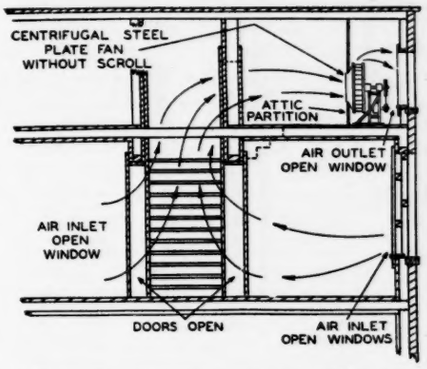
In the discussion it was mentioned that a serious objection to the use of attic ventilating fans was the noise, and the suggestion made that serious thought be given by manufacturers to eliminating this. E. K. Campbell replied to this question by stating that by using large fans run at slow speed this difficulty could be overcome.

"A Proving Home for Air Conditioning Investigations" was described by Elliott Harrington, co-author with Leon A. Mears in describing the house equipped by General Electric in Schenectady, N. Y., with the objects of improving air conditioning apparatus; improving application and installation standards; accumulating data on the benefits of air conditioning to comfort and health, and for general public education on matters pertaining to air conditioning.

The house is equipped with an oil-fired boiler, central air conditioner, a cooling attachment for the air conditioner, two refrigerating units, and an attic ventilating fan.



Centrifugal fan with exhaust ducts, as tested in Detroit



Alternate arrangement for attic cooling with fan installed without scroll

In commenting on the paper, Prof. A. P. Kratz pointed out that the endeavors of the authors to maintain ½° per ft. temperature differential between the floor and ceiling was dependent on the outdoor temperature and stated that this could be accomplished easily in 40° to 50° weather, but that in zero weather the differential may be as much as 2° per ft.

Oil Burner Studies Continued by Seeley

"Study of Fuel Burning Rates and Power Requirements of Oil Burners in Relation to Excess Air" was the title of a paper presented February 8 by Prof. L. E. Seeley, and E. J. Tavanlar. They pointed out a number of conclusions they had reached, as follows:

Maximum fuel-burning range of an oil burner is obtainable, according to fixed operating standards, when the standard requires a low excess of air (or high CO_2).

The maximum fuel-burning rate at low excess air may be increased by increasing the furnace draft.

The possible variation in operating standards (i.e., per cent of excess air) is reduced at the high fuel-burning rates. In other words, more economical fuel-burning conditions are assured.

There is a certain range in fuel-burning where it would be possible to have any excess of air from 50% to 625%. The probable economy of fuel burning in this range would be highly speculative, assuming the absence of any standard of operation.

Very low fuel-burning rates make increases in excess air mandatory. Efficient fuel burning becomes virtually impossible.

Air delivery from the fan of the burner used in the Yale tests falls off with an increase in the fuel-burning rate, even though the air adjustment remains fixed. To what extent this is a characteristic of all oil burners is not definitely known.

Any statement in regard to fuel-burning rates of an oil burner should preferably be qualified by operating standards relating to excess air (or CO_2) and furnace draft.

Prof. G. L. Larson read a written discussion on this paper by Prof. D. W. Nelson, of the University of Wisconsin, in which Professor Nelson stated that 10% CO_2 in the flue gas from an oil burner is a reasonable requirement although it has been considered an impossibility by many dealers in the past. He quoted a survey then under way by CWA workers in Madison, Wis., covering 40 oil burner installations, the average CO_2 for the 40 being 8.1% with an average flue gas temperature of 524°. Seven of the installations had flue gas temperatures less than 300° and CO_2 of more than 9%. Most of these seven, however, had extra heating surface in the way of economizers. Professor Nelson claimed that in order to obtain a good combustion low cost air and a low rate of oil burning are necessary. In his opinion, the majority of burners now being installed are too large for small residences.

Brabbee Analyzes Boiler Design and Rating

Dr. C. W. Brabbée, director of American Radiator Company's Institute of Thermal Research, presented a paper entitled "Design and Valuation of Cast Iron Domestic Heating Boilers." Doctor Brabbée pointed out that European tests have shown that a combustion chamber with "pinched" grates—that is, grates narrower than the walls of the combustion chamber—give better results than grates wider than the chamber, or even those of the same width. He said that the width of the grate is only one of several other points which should be considered, such as, total grate area; grate bar construction; dimensions of grate teeth; effect of teeth on front and back sections, etc.

Neither is it, according to Doctor Brabbée, correct to rate cast-iron boilers on the heating surface alone. He further concluded that judgment of boilers based on their stack temperatures also leads to erroneous results, especially if the influence of the products of combustion is neglected.

The speaker summarized his experience with boilers as follows:

A boiler must be able to deliver in the morning the necessary output easily and quickly, also under the most exacting and severest conditions of rapidly changing weather.

A boiler with too much heating surface and, therefore, a too low stack gas temperature will, even with laboratory efficiencies of 80%, be unsatisfactory if its chimney cannot develop the draft necessary to obtain quickly the required high output.

A boiler must be able to do such emergency work even with the poor chimney conditions frequently encountered in actual practice.

Replacement of a highly efficient boiler by one which has 2% or 3% less efficiency is not only justified very often but works in the direction of higher "Useful Service," as it gives easily and quickly everything that the consumer wants and with satisfactory fuel consumption.

The economical operation of a house-heating plant is less influenced by the boiler's efficiency during severe weather than during the many weeks when the system works at one-half or one-third, or even less, of its rated capacity.

During those times correctly selected boilers need attention only at long intervals despite the fact that the combustion chamber is never filled up to the crown-sheet. The boiler then works with a relatively shallow fuel-bed, with low stack gas temperature, and without CO, performing differently than under certain official test conditions not experienced in the field.

Using Hot Water Circulators

"Heating Buildings with Hot Water" was the title of a paper by B. F. Burt and S. R. Lewis, presented by H. L. Alt, due to the absence of the authors. According to Mr. Alt, the paper related primarily to the small circulating units used in connection with residence hot water systems.

A zone must be established wherein pumpage is economical and where pipe sizes will be reduced intelligently to correspond, and where the temperature drop through the boiler and radiators gives a rationally balanced efficiency. Herein appears the engineering skill and experience required for design of hot water heating.

A new modern mechanical circulation piping system is very similar in general layout to a two-pipe vacuum steam system in that each radiator received a supply connection from the flow system with a return connection to the separate return system. There are no connections from the supply mains to the return mains except through radiators, and the head which causes the water flow is exerted positively on every radiator.

There are available automatic valves which may be placed on the various main circuits which will throttle the flow due to the pressure in the corresponding return, to which their pressure-sensitive elements are connected. Each automatic valve may be adjusted to permit the existence of the necessary pressure difference and no more, required to overcome the resistance of that particular circuit, thus making any surplus pressure available for use on the less favorable circuits.

The same automatic throttle valves may also be controlled by divisional thermostats so as to reduce the water flow as the room temperature increases. This permits the adjustment of the zone temperature automatically as the sun finds its way around the East, South, and West sides of a building. In northern cities the winter sun at noon looks far into the rooms and its radiant heat warms up the floors and furniture and renders zone control of the type described exceedingly valuable, especially in office buildings.

The authors believe that:

Heat transfer by forced liquid which is forced to circulate independently of thermal conditions has many advantages.

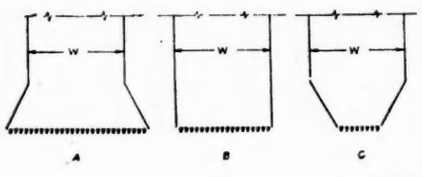
The value of having a variable mean effective temperature of the heat transmitting medium cannot be overemphasized. Savings in fuel and in comfort invariably attend heating systems which adjust the mean effective temperature of the heating medium to suit the varying demand. Such systems reduce greatly the difficulty of temperature control.

They lend themselves admirably for adaptation to cooling as well as to heating and are capable of providing service hot water as effectively as do steam heating plants.

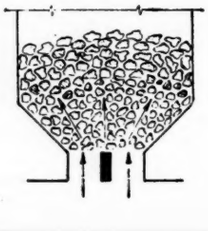
Old liquid heating systems not having pumps can be improved and corrected by installing modern electric circulators.

Inasmuch as the authors used some of the new nomenclature, such as kB, which have not as yet been formally adopted by the Society, exception was taken to such use by W. L. Fleisher.

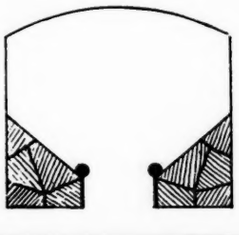
Perry West in the discussion called attention to the fact that the authors designed the piping system with the same loss per foot of piping throughout the system, whereas water systems are designed with the same total loss in each circuit. Mr. Alt in reply to this point stated that he did not know whether this statement was intentional or not.



(Left) Three designs of combustion chambers. C is better than B; B is better than A. (Below) An improvement on open fireplaces



(Right) Barlach, a European engineer, designed this one grate combustion chamber for industrial stoves



Relation of Health to Indoor Air Conditions

THE effect of climate, air conditioning, carbon monoxide, air circulation, and other factors affecting indoor air conditions on the health of human beings, were discussed in a number of the papers at the A.S.H.V.E. meetings. Among these were "A Study of the Ion Variation of Both Indoor and Outdoor Air," and "A Study of the Effect of Air Conditioning on Hay Fever Sufferers."

Effect of Climate on Health

Dr. C. A. Mills, professor of experimental medicine, University of Cincinnati, presented one of the most popular papers at the meeting — "Air Conditioning in its Relation to Human Welfare." He showed that daily variation in temperature stimulated the activity of human beings, but this apparently results in an early breakdown of the body. Doctor Mills correlated vital statistics covering diabetes, anaemia, cancer, goiter, and other diseases with data on the Climatic Drive, showing that these diseases, which seemingly are connected with body breakdown, are in proportion to the extent of the Climatic Drive. Doctor Mills predicted the use of air conditioning for animal husbandry in the South before it is used to any extent for human beings. He further predicted an increasing use of air conditioning in hospitals.

Discussions on the paper included those of Thornton Lewis, Margaret Ingels, etc.

Charles F. Neergaard, hospital consultant, read a paper "Engineering in the Hospital of Tomorrow." He prophesied that in the light of past experience and present knowledge of planning, construction, and equipment, and based on hope, perhaps, rather than prophecy, the hospital of tomorrow is going to be built at from 25% to 40% less cost than the hospital of 1930, given the same labor and material levels. The fixed charges for operation and maintenance, interest and insurance, must be reduced in even greater ratio.

He further predicted that the 100-bed hospital structure will be smaller than its 1930 prototype, lighter, more compact, quieter, longer lived, and with a better insulated envelope. The mechanical services, simpler and more efficient, will provide better conditions for patients and those who care for them.

Perhaps the most popular recommendation which could be made for heating and ventilating the future hospital would be to turn the entire problem over to the air conditioning engineer and let him install a central plant with a robot in the engine room surrounded by registering and recording gauges, and instruments of precision, with which to regulate all of the elements of heat and cold, moisture and clean air throughout the building. Admittedly, the hospital of the future must have better air. It must keep pace with the findings of the physiologist and provide whatever will contribute to the safety or cure of the patient, but every item of increased expense must be conclusively vindicated.

Discussion on this paper included that of Dr. A. A. Adler, H. H. Angus, and others.

"Study of Air Conditioning and Office Employees' Efficiency," by Dr. W. J. McConnell and I. B. Kagey, was presented by the former. Doctor McConnell described the conditions maintained during the past summer in the Metropolitan Life Building.[1] Among points mentioned by the speaker was that in December a dust count was taken and showed 1.2 million particles per cubic foot in this conditioned building as compared with a count of 2.9 millions per cubic foot in an unfiltered space in the same vicinity.

Doctor McConnell said that they had not been able to find any practical method of measuring the increase in efficiency of the workers due to air conditioning.

[1]A description of this building appeared in the August, 1933 issue of HEATING AND VENTILATING.

Mr. Kagey then described the installation and showed slides illustrating it.

Prof. A. H. Sluss, of the University of Kansas, presented a progress report on the study of bus and garage ventilation entitled "Carbon Monoxide Surveys of Two Garages." E. K. Campbell and Louis M. Farber were co-authors. They stressed the following points:

In most garages there is no carbon monoxide hazard, except in cold weather when it is necessary to close the doors and windows.

Ventilation with unheated air is not feasible during cold weather.

Carbon monoxide concentration tended to increase in unswept portions of the room.

The amount of air necessary to eliminate the carbon monoxide hazard in a garage may be reduced from the theoretical volume, providing it is properly introduced into the unswept portions, thereby driving the mixture into the swept portion where it can be disposed of by infiltration.

The permissible reduction from the theoretical volume of 5000 c.f.m. per idling car is in proportion to the volume of infiltration effectively utilized.

Outside air used to dilute CO and sweep otherwise dead corners and pockets must be heated sufficiently to maintain comfort, and it was found that extra heat introduced with the outside air allowed a considerable increase in infiltration without increasing discomfort.

A.S.H.V.E. OFFICIALS ASSEMBLE AT CONVENTION

Seated: C. V. Haynes, newly-elected president; W. T. Jones, 1933 president; John Howatt, new first vice-president. Standing: C. F. Roth, exposition manager; J. D. Cassell; Roswell Farnham; W. H. Driscoll, past president; R. H. Carpenter; F. C. McIntosh; E. K. Campbell; G. L. Larson; E. H. Gurney; D. S. Boyden; J. F. McIntire, and F. E. Giesecke.

New Yale Laboratory Described

"Design and Equipment of the Pierce Laboratory" was the subject of a paper by C.-E. A. Winslow, Leonard Greenburg, L. P. Herrington, and H. G. Ullman, and presented by Doctor Winslow. The laboratory, located at Yale University, was built by funds from the John B. Pierce Foundation, established under the will of the late John B. Pierce. The object of the Foundation is the promotion of research, educational, technical, or scientific work in the general field of heating, ventilation, and sanitation. The Foundation officers are Clarence M. Woolley, president; Rolland J. Hamilton, vice-president, and Henry L. Weimer, secretary and treasurer.

For nearly two years work has been in progress on the design and construction of a laboratory for researches relating to the physiological effects of various atmospheric conditions, particularly those due to radiation of various types and electrically-charged particles. The Laboratory of Hygiene was formally opened on November 4, 1933. While an independent institution, it will be operated in affiliation with the Department of Public Health of the Yale School of Medicine, under the direction of the senior author.

Since the approach must be a broad one, primarily from the standpoint of human health and comfort, the staff has been so organized that medicine, physiology, and psychology, as well as engineering and physics, are represented by competent experts.

Ion Variations Studied

Prof. C. P. Yaglou and L. Claribel Benjamin, both of Harvard University, were authors of a paper "Diurnal and Seasonal Variations in the Small-Ion Content of Outdoor and Indoor Air," presented by Professor Yaglou.

The most important climatic factors affecting the small-ion content of outdoor air appears to be the interdiurnal changes of temperature and humidity. A drop in the interdiurnal temperature and humidity is as a rule preceded or accompanied with a sharp rise in the ion content of air, and vice versa, provided that the drop or rise in temperature and humidity does not continue more than two days.

Cloudiness, high humidities, and light or moderate precipitation of any kind have a detrimental effect on the small-ion content of outdoor air. Heavy precipitation results in a considerable increase in the number of small negative ions, and when the precipitation is accompanied with thunder and lightning, both positive and negative ions attain very high values.

In the locality of Boston, high concentrations of small ions are as a rule associated with winds from the west and northwest, which usually bring sharp drops in the interdiurnal temperature and humidity and clear weather. The actual temperature and barometric pressure are not very important so long as the relative humidity is well under 75%.

Low concentrations of small ions are generally associated with stormy winds from the east and northeast, which are often preceded with a rise of temperature and humidity finally culminating in rain or snow. The minima occur in damp or moist weather when the temperature is under 50°.

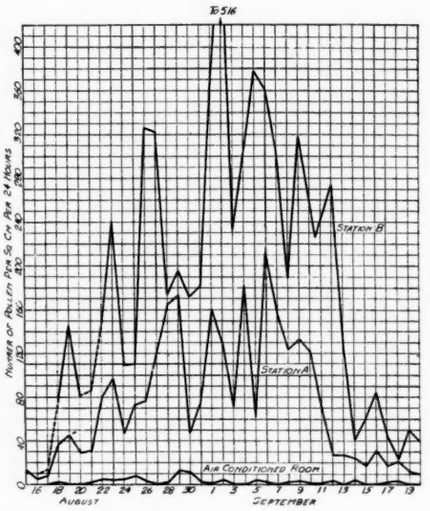
In winter, the concentration of small ions in indoor air is considerably lower than that in outdoor air. In summer, the reverse seems to hold true. Adverse weather of short duration does not conspicuously affect the indoor concentration in spite of powerful effects on the outdoor ions. Persistent bad weather tends to equalize the outdoor and indoor ion numbers.

In the light of the present study it would seem that the small ion content of the atmosphere is an important meteorological factor which deserves wider recognition and more study than heretofore afforded to it.

Effect of Air Circulation on Hay Fever

W. H. Driscoll presented the paper "Observations of Hay-Fever Sufferers in Air-Conditioned Room and the Relationship Between the Pollen Content of Outdoor Air and Weather Conditions," by T. A. Kendall and Garland Weidner. This paper was scheduled to have been presented by Dean F. Paul Anderson, of the University of Kentucky, who is convalescing from a serious operation and was unable to attend. The report contains results of tests begun in the beginning of the hay fever season in 1932 and continued through 1933.

All of the 40 visitors selected for study received some degree of relief in the air conditioned room. Satisfactory relief was obtained upon about 90% of all visits made by these patients.



Daily pollen count and weather conditions during ragweed season, Lexington, Ky., 1933; from tests on hay fever patients in conditioned rooms.

Records of other visitors were unsuitable for study because in some cases symptoms were of a degree too mild for the observation of relief, and because in other cases in which relief was obtained the patient either could not be kept under observation or other pertinent data could not be obtained.

Some cases received relief while in the room but failed to visit the room often enough to allow for sufficient study. Two principal reasons given for failure to visit the room were that the patients lived too far away, making trips inconvenient, and attacks appeared on the way to and from the hall, so that the patients preferred to remain at home.

The various common symptoms usually experienced by hay-fever sufferers received different degrees of relief. Sneezing and irritation of mucous membrane received the greatest amount of relief. Irritation of the eyes, facial irritation and nasal discharge received a moderate amount of relief. Nasal blockage, headache, and general depression or fatigue received the least amount of relief.

The data do not show conclusively how much relief is due to filtration only and how much is due to the more comfortable temperature and humidity which prevailed within the air conditioned room as compared with less comfortable conditions in other rooms. The fact that the patients *preferred* the air conditioned room would merely confirm the judgment of normal persons.

There was occasionally an exceptional case that was made more uncomfortable in the cooler atmosphere of the air conditioned room.

The observers were impressed with the need in all cases of medical diagnosis and sensitivity tests to determine the specific cause of symptoms.

A written discussion by H. C. Murphy was presented by C. W. Obert. Mr. Murphy quoted from a paper by Leslie N. Gay, who said that relief from hay fever depends not only on the air being cooled but also on its being cleaned.

H. B. Johns, of the Peoples Gas, Light and Coke Company, pointed out that tests at the University of Illinois had indicated that asthma patients had recurrence of their troubles during thunder storms, a point which has not been explained up to date. Dr. Charles Davies commented that although air conditioning may be valuable in certain cases, nevertheless it cannot be guaranteed to produce relief and that physicians should be cautious in forecasting what results they may be able to obtain in the use of air conditioning equipment.

W. K. Walker, in discussing the paper, said that he understood there were several different kinds of asthma and wondered if a distinction among the different kinds had been made in the tests run on asthma patients.

Manufacturers Discuss Possibility of Basic NRA Code for the Industry

A PROPOSAL for unifying a number of NRA codes for different branches of the heating, ventilating, and air conditioning industry was presented to a meeting of manufacturers held in the Hotel Biltmore, February 10, by Beverly S. King[1], NRA Deputy Administrator from Washington. W. T. Jones presided.

The plan as proposed by Mr. King is that a code authority committee would be set up composed of the chairman of each industry control committee with non-voting members appointed by the Administrator. The industries to be covered under this plan include: Fans and Blowers; Unit Heaters; Steel Heating Boilers; Non-Ferrous Radiators; Radiators and Boilers; Warm-Air Furnaces; Steam Equipment; Air Filters; Indirect Water Heaters; Tank Water Heaters; Cast Warm-Air Grilles; Unit Coolers; Furnace Blowers; Control Instruments; Domestic Stokers, and Pipe Covering. Each of these industries would have its own separate code and its own code authority. The plan provides for a master basic code with a coordinating administrative body.

[1]This plan was described in some detail in the January, 1934 issue of HEATING AND VENTILATING, pages 30 and 31.

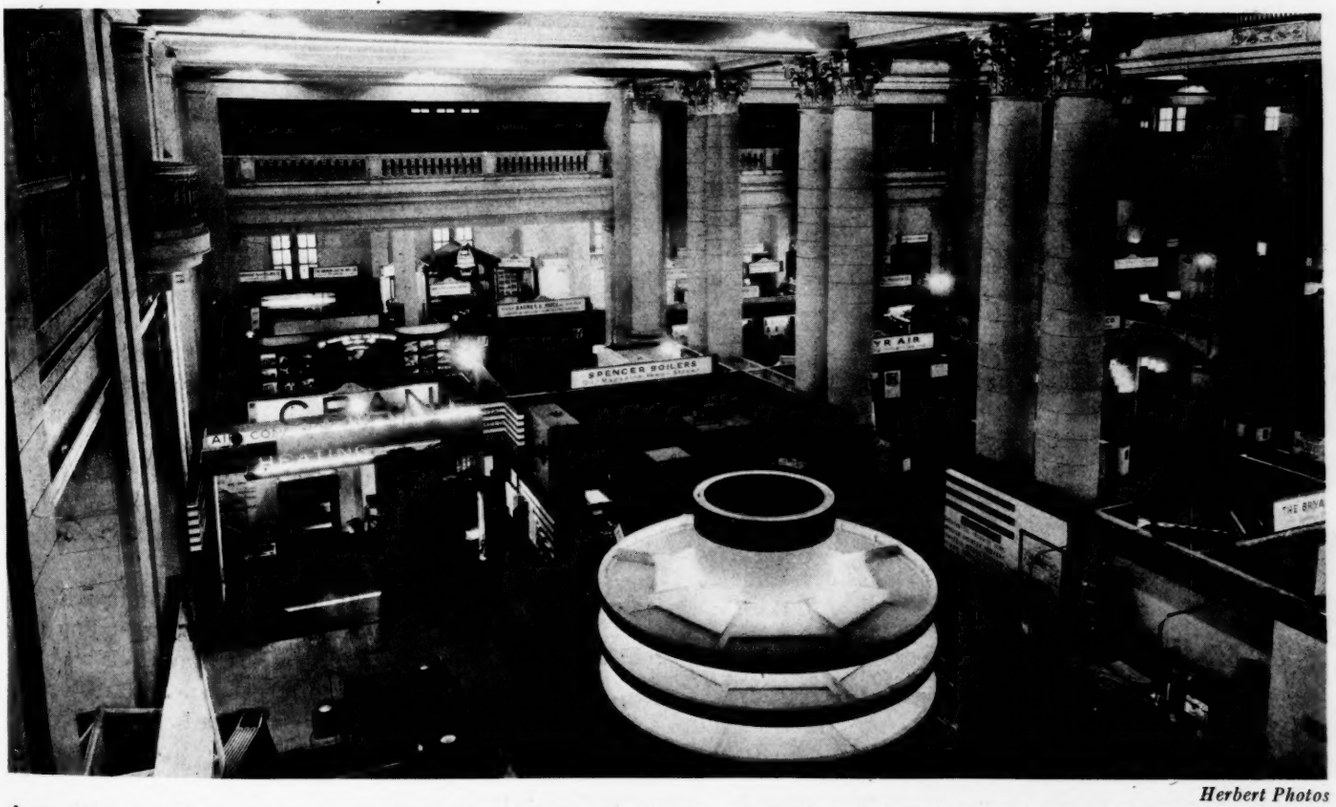
The idea was proposed by Mr. King solely to simplify the procedure in administering the codes, to save in the cost of administration, and to secure coordinated action in the industry. He stated that the idea was put forth as a suggestion. The meeting was then thrown open with the idea of discussion and possibly action. It was pointed out that the industries represented in the proposed plan had an invested capital of about $250 million with a productive capacity of about $280 million per year and consisted of about 300 firms.

E. K. Lanning, of Warren Webster & Company, and representing the Steam Heating Equipment Manufacturers Association, said that he favored such a proposal and believed that it could be carried out.

A motion was made by Mr. Lanning and passed by the meeting to the effect that a temporary committee, consisting of members of Code Authorities who were present, should hold a meeting to determine whether a basic code was desirable, and if so, a committee should be appointed to consider a basic code. The chair appointed G. E. Otis as chairman of that committee.

Discussions included that by H. T. Richardson, Jr., who felt that the problem of unifying these codes would be difficult. G. E. Otis, The Herman Nelson Corporation, favored the proposal, inasmuch as he thought that operating under such a large number of small codes might not be allowed by NRA indefinitely. Reuben Trane, president of Trane Company, favored the proposal, while J. C. Chambers, sales manager of the Air Conditioning Division, Frigidaire Corporation, pointed out that one thing that should be kept in mind is that some of the newer concerns in the air conditioning field have different merchandising problems than the older, since the former use dealers and retail sales outlets to a degree and that this difference in merchandising plans must be kept in mind in framing a master code.

Following the general meeting, the interested members of Code Authorities held a meeting and formed a temporary organizing committee. G. E. Otis presided. It was decided to send out a questionnaire which will include an explanation of the objectives of the proposal. If, following this, it appears desirable to go further, it seems that rapid progress may be made toward formulation of a Master Code.



Herbert Photos

A partial view of the Third International Heating and Ventilating Exposition at Grand Central Palace, New York, Feb. 5-9

Large Attendance at Exposition in Spite of Cold

NEARLY 54,000 men and women visited Grand Central Palace, New York's famous exhibition hall, the week of February 5-9, the occasion of the Third International Heating and Ventilating Exposition held in conjunction with the 40th annual convention of the American Society of Heating and Ventilating Engineers. Visitors and exhibitors alike were enthusiastic in their expressions of satisfaction with this biennial event in the heating, ventilating, and air conditioning industry, and many manufacturers report that a revival of demand for the products of the industry was strongly in evidence in the attitudes of those who attended.

The booths of each of the 147 exhibitors merited more than a casual inspection, a great majority of them having on display entirely new developments, while others were showing interesting refinements of older established lines and products. Live exhibits, with appliances in actual operation, and with skilled demonstrators putting the various appliances and equipment through their paces, evinced the keen interest of the visitors. Many sales, resulting directly from the exposition, were reported.

Perhaps most noteworthy of the impressions conveyed to the observer at the show was the marked tendency of manufacturers to dress up their merchandise. Boilers, radiators, unit heaters, conditioning units, automatic firing devices, and control appliances, formerly accepted in drab and unsightly forms, have emerged resplendent in tasteful modern enclosures, finished in harmonizing colors, and truly possessed of beauty. Apparatus that once bristled with countless fixtures, trimmings, and moving parts, now presents a compact and pleasing appearance, with straight lines dominating the design, and often with no other projection than a single control button.

A second important trend noted at the show was the tendency of manufacturers to stress the small, individually-sold units. Conditioning equipment for residences, offices, small commercial establishments, and similar applications was much in evidence.

Many and varied were the products on display. Nineteen boiler manufacturers were represented, and 16 automatic firing devices, including oil burners, gas burners and automatic stokers, were exhibited. Specialty and auxiliary manufacturers, whose products included valves, traps, pumps, etc., numbered 22. Twelve makers of control equipment, embodying such apparatus as thermostats, humidistats, and motor valves, displayed their wares. Ten manufacturers exhibited air conditioning units for room installation, and several others had central air conditioning equipment on view.

Furnaces and related equipment for forced air heating installations by 10 manufacturers were shown. Other exhibits included those of six makers of heating surfaces, both direct and indirect, five manufacturers of electric motors, six producers of pipe and tubing, four makers of insulation, four instrument manufacturers, four humidifier manufacturers, four fuel producers, several makers of equipment for domestic water heating, and a large number of accessory manufacturers.

From the engineers' standpoint, undoubtedly the most outstanding achievements since the last exposition are the developments that have been made in apparatus for the automatic control of heating, ventilating, and air conditioning systems. The early faults of automatic control, the tendency to overheat and to underheat, and the failure to maintain steady indoor conditions in the face of fluctuating outdoor conditions, have received the attention of the manufacturers of this equipment, and several of them were showing for the first time at the exposition their various devices for overcoming this difficulty.

Wide World

The pyroheliometer for determining intensity of heat radiation from the sun was a feature of the A.S.H.V.E. booth at the exposition. The instrument is used at the society's research laboratory at Pittsburgh.

Unventilated Factories Shorten Workers' Lives

By J. D. HACKETT†

THE great art is to get the most out of life with the least expenditure—of effort, of money. It comes as a revelation to the world at large that industry shortens life, yet such is the fact, proved beyond yea or nay by statistics which the common man never sees, and, should he see them, it is doubtful if their full significance would strike him. Yet they tell a significant message to the industrial hygienists, and, when analyzed, show clearly enough that the worker who enters industry will die perhaps five or six years earlier than had he devoted his life to agricultural work.

The cause of this shortening of life is not readily apparent and were the question tendered to 100 persons, doubtless each would have a different answer. But on examination the answer is as clear as it can be. It is not wages, for wages are higher in industry than in agriculture; it is not hours, for hours are longer in agricultural work than in industry. There is one essential difference between the factory and the farm and that is air.

Whatever kind of work the farmer does is in the open air. Factory work is usually done in confined spaces accompanied by dust, fumes, and gases—and there's the rub. Now, it is apparent from the above that the great secret of factory health is ventilation, that great science which deals with a most fluid, elusive and delicate substance. The question is not simple. Ventilation embraces much, of which temperature, air movement, humidity, and air purity are but a part. The ventilating engineer must energetically operate in this field if we are to preserve the health of the workers.

Very little impression has as yet been made on this problem, especially from a fundamental approach. Anybody who understands the complexity of industry will at once agree that the solution of the ventilation problems is different in every plant. Therefore, there is all the more reason for considering ventilation as a fundamental question of plant design. How few manufacturers consider ventilation until forced to it by the operations of the labor law. Then the ventilation engineer is hired to take care of a problem which could have been satisfactorily dealt with only at the beginning—the sad feature of the case being that it costs more to work in this way than the other.

Integral hygiene is the solution. No plant should be built, no manufacturing should be set up, without the application of ventilation principles to the enterprise as a whole. The state of New York is conscious of all this, and, in order to promote the effective ventilation of industrial plants has, in the Department of Labor, a Division of Inspection which administers the labor law. Section 299 of this labor law provides that all factories shall be freed from dusts, gases, and fumes dangerous to health. Further, the State Department of Labor maintains a Division of Industrial Hygiene, the function of which is to give employers advice as to the dangers of various substances and as to the appropriate method of ventilation for them.

This Division tells employers how the labor laws may be complied with. It is equipped with a medical, engineering, and chemical staff trained in industrial hygiene, whose duty is to inform employers as to the maintenance of hygienic conditions in plants and to give advice on such matters free of cost to anyone who cares to avail himself of their services.

Even in the last 10 years great fundamental changes have taken place in the manufacture and use of substances. Perhaps twice in that period the whole character and even use of paint materials has been radically changed, relieving us of the old hazard of lead poisoning and instituting a new one, more dangerous because it had been previously unknown. Some employers purchase materials, the composition of which is unknown to them. They are unaware of the hazard, and even of the fact that there is a hazard. They can get information as to this point for the mere asking. In a recent court case the manager of a plant declared that up to a year or two ago he was unaware that silica dust was capable of creating an incurable disease, now known to the world as silicosis. There is one solution to this problem—removal of the dust at the point of origin—and yet there are still employers unaware of the danger. They declare that the best evidence of the healthiness of the work is the appearance of the workers. They have no conception that the disease gradually grips a man's lungs and that many a worker has gone home to die, neither he nor his employer realizing the cause. Some employers are so far from having any comprehension of factory hygiene that, in order to save heat, they have adopted the plan of recirculating air. It is doubtful if this is an economy under any circumstances and should not be considered by anyone who has a sense of the value of good air.

There is no question but that ventilating engineers are competent to solve any hygienic problem and the best proofs of this are the extraordinary results that have been obtained where the conditioning of the product demands it. But, when the proposal is made to manufacturers to use the same talent for preserving the health of the workers they are deaf to appeal. They do not know that the lowered vitality of workers may be a considerable factor in reduced production and that the savings effected by the provision of proper ventilation may easily offset the cost incurred in providing it.

†Director, Division of Industrial Hygiene, New York State Labor Department.

Your Everyday Problems

HEATING AND VENTILATING will be glad to answer your problems relating to installation and operation of heating and ventilating systems. Letters will be answered promptly, and in some cases published anonymously. If sketches are included they should be clearly drawn. Write The Editor, HEATING AND VENTILATING, 148 Lafayette Street, New York.

QUESTION 109. *What are the most common scale-forming impurities found in city water used for boilers? Is there any simple test to determine if they are present?* *J. J. M.*

ANSWER. Scale-forming impurities found most frequently in boiler water are calcium carbonate and calcium sulphate. The services of an expert chemist are required to determine in what quantities these materials are present, but there are simple tests that can be made to discover if they are present in appreciable amount.

To test for calcium carbonate, a small amount of aqueous ammonia and ammonium oxalate is added to a sample of the water in question and the mixture heated to the boiling point. If calcium carbonate is present, a precipitate will be formed.

To test for calcium sulphate, a small sample of the water, to which a few drops of hydrochloric acid and a little barium chloride have been added, is heated slowly. If a white precipitate is formed that does not redissolve upon the addition of nitric acid, calcium sulphate is present.

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QUESTION 110. *We are heating a small office building with steam reduced to approximately* 15 *lb. from the* 150-*lb. pressure carried in the boiler supplying steam to several uniflow engines in our power plant. The reducing valve is of the diaphragm type, regulated by a weight and lever. We have experienced a great deal of trouble with this arrangement, the valve having a marked tendency to pulsate, opening and closing rapidly, and causing considerable noise and an unsatisfactory operation of the heating system. Is this caused by fluctuations in the line pressure, perhaps due to the reciprocating engines, and if so, how can the difficulty be corrected?* *B. C. Co.*

ANSWER. Your difficulty may be due to pressure pulsations in the line resulting from the operation of the reciprocating engines, in which case a remedy for the condition would be rather difficult. Perhaps the substitution of a less sensitive reducing valve or a rearrangement of the connection of the heating main to the high-pressure steam would help. However, a frequent cause of this condition is that the connection from the low-pressure main to the diaphragm of the reducing valve is made too close to the valve.

This diaphragm connection should be tied in to the low-pressure heating main at a distance of not less than 12 ft. from the valve, and at a greater distance if possible. If this connection is made close to the valve, the high-pressure steam has not fully expanded to the lower pressure at that point. The pressure at the connection, being higher than that further along the main from the valve, causes the diaphragm to close the valve. When this takes place, the pressure drops immediately in the low-pressure main, and the valve is again opened. This series of events takes place rapidly, causing the fluttering or pulsating as described in your question. It is suggested that you check up on this connection before changing the valve or making other changes.

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QUESTION 111. *Tenants in an apartment building are complaining about an odor of coal gas which occurs after the fires have been banked at night. It is our understanding that such an odor results from incomplete combustion of the fuel, and yet there is practically no unburned coal in the ash. When the fire is banked, the janitor closes the ashpit door, and generally opens the slots on the fire door. The odor seems just as strong when these slots are closed.* *J. E. H.*

ANSWER. In addition to being objectionable, the "coal gas" often contains carbon monoxide, and is therefore dangerous to breathe. This gas is produced by a chemical reaction within the furnace, rather than by incomplete combustion.

When coal, which consists primarily of carbon, is burned in oxygen, carbon dioxide, a harmless and odorless gas is formed. This gas has an affinity for carbon at high temperatures, and as it passes upward through the hot unburned coal lying just above the fire in a banked furnace, some of the molecules of carbon dioxide take on an extra atom of carbon to form carbon monoxide. If the upper part of the firebox is sufficiently hot to ignite the carbon monoxide, and there is enough oxygen present, the gas will burn to form carbon dioxide.

When a coal fire has been banked and the draft cut down, the chimney cools down and there is less draft to carry the products of combustion up the chimney. Under these conditions, there is a greater possibility for the gases to gain access to the cellar through the fire door and through leaks in the smokepipe and breeching, especially if the chimney is small or there is any obstruction or dirt in it or the smokepipe. It is therefore suggested that the boiler and smokepipe be checked for leaks, and the chimney checked for faulty draft.

Abstracts . . .

**Reviews and Summaries of. . . .
Current Papers, Books and Pamphlets**

Reference Catalog of Heating Boilers

The Pape-Swift boiler reference book contains the capacities, dimensions, and other engineering data as copied directly from the pages of the catalogs of 35 manufacturers of heating boilers. This material has been compiled to provide a compact and ready reference for determining the ratings of boilers for the convenience of oil burner, stoker, and gas burner salesmen, engineers and architects. The book is indexed.

[*"The Pape-Swift Boiler Reference Book," published by John S. Swift Co., Inc.,* 105 S. 9*th St., St. Louis. Paper-bound;* 5¼ *in.* × 8¼ *in.;* 400 *pages; price,* $1.]

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Development of Air Conditioning

Air conditioning found its conception in industry when it became evident that control of the temperature and humidity of the atmosphere in which certain products were processed was economically feasible. The author of this paper briefly traces the history of the air conditioning industry, now 25 years old, from the time when its chief concern was the effect of temperature and humidity upon the products of the textile, printing, and other industries, up to the present time when the promotion of human comfort and health has become its primary function.

Concentration of manufacturing activities, born of the industrial revolution, necessitated air conditioning for the sake of the products, and similarly the concentration of living and working quarters in cities has brought about the need for proper atmospheric conditions for the comfort and well-being of the inhabitants. A discussion of the physiological influences of the various factors controlled in air conditioning follows, together with an outline of the conditions to be met for comfort as determined by the most up-to-date research in the field.

Air conditioning as a means of removing the heat produced incidental to the illumination of buildings is then discussed. The author shows how the heat load so produced is many times greater in modern lighting practice than it was in former practice. The paper also gives considerable attention to the problem of acoustics as it relates to air conditioning. Although air conditioning makes possible the shutting out of noises originating outside of a building, the apparatus itself must be carefully designed to eliminate its own operating noises. Other design problems, including the limitations imposed on the equipment by the necessity for avoidance of drafts, the design and placing of inlets and outlets to harmonize with the architectural design, etc., are touched upon, with a brief description of the development of the by-pass method of controlling temperature and humidity.

The latter part of the paper is devoted to a study of the various sources of heat load in buildings, evaluating the various factors, and describing how the computations for the total load are made. The author concludes with a brief general description of the types of equipment applied to air conditioning ir present practice, with statements as to the industry's present status and predictions as to its future.

[*"The Development of Air Conditioning in Industrial, Residential and Public Buildings; Its Effect on Human Beings; The Factors which Enter into Its Design," by P. L. Davidson. A paper presented before the* 26*th annual meeting of the American Institute of Chemical Engineers, Roanoke, Va., December* 12-14, 1933. *Contains a bibliography of references; appendix of illustrations; approximately* 14,000 *words.*]

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New Edition of Chemical Handbook

The 18th edition of the Handbook of Chemistry and Physics, a valuable reference book that deserves a place on the bookshelf of any engineer, has appeared. The new edition, containing many revisions and additions, represents a 20-year accumulation of information and data essential in the commercial, educational, and research laboratory.

Important revisions have been made in the table of physical constants of inorganic compounds, to which nearly 1000 new compounds have been added, together with more complete and recent data for those previously listed. Other important revisions are evident in the sections dealing with the chemical elements, characteristics of thermionic tubes, isotopes, photographic plates and films, etc. Eight pages of new material, giving the prime factors of all factorable numbers, and the logarithms of all prime numbers from 1 to 2000, have been added. The book contains 220 pages of mathematical tables and formulas, 44 pages on properties of matter, 135 pages on heat, 54 pages on sound, electricity and magnetism, 204 pages on light, 134 pages of measures and units, in addition to 800 pages of chemical tables.

[*"Handbook of Chemistry and Physics," Eighteenth Edition, published by Chemical Rubber Publishing Co., Cleveland, Ohio;* 1818 *pages,* 4¼ *in.* × 6½ *in.; price* $6.00.]

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A. S. H. V. E. Papers

Editor's Note—Summaries of many of the valuable papers presented at the 40th annual meeting of the A.S.H.V.E., New York, February 5-9, which would normally be abstracted in this department, will be found in the report of the meetings on pages 35-44, inclusive, of this issue of Heating and Ventilating.

EDITORIALS

Construction Code

ON January 31 the President approved the code for the construction industry. The several chapters regulating the work of each group are still awaiting approval. Approval of the basic code, however, assures the carrying out of the plan of recognizing construction as a single integrated industry. Leaders have dwelt upon the importance of this point and have confidently predicted that recognition of this principle would go a long way toward helping the whole building industry. The long-drawn-out fight over the rights of labor to be represented on the wage-fixing body is recognized and a special board is provided to study the wage situation. This feature is unique in the construction code. Approval of the basic code in its present form seems like a definite step forward and one which should help to bring results soon in the way of an increased volume of building activity.

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A Favorable Outlook

THERE are plenty of reasons to feel optimistic over immediate business prospects. The government money is at last beginning to make itself felt in the purchase of equipment for buildings. Plans continue to be drawn and the backlog of contemplated work is impressive in amount. Some contracts are really being let. The NRA codes—both manufacturing and construction—are on the verge of becoming definite. Plans for making money available for long-time loans are making progress. The banks are open and the dollar is relatively stable. Retail trade has been unexpectedly good in the past few months. We are getting through an especially severe winter without the horrible social results so freely predicted. Leaders report a new attitude of confidence on the part of many who heretofore could see nothing but trouble ahead. We are not yet out of trouble but the favorable factors at present are more numerous and weighty than they have been for months.

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Mortgage Money

EQUITABLE and adequate finance for building construction and repair is rapidly coming to be recognized as the most pressing problem of the day. There are really two separate aspects to the subject. One is how to straighten out the tangle which has resulted from past bad practices and the other is to devise means which will attract private capital back into the building field. It is hard to tell to what extent the present low state results from past bad practices or to the lack of sound and appealing plans for the future. Certainly both factors are acting and both help to account for the present state of affairs. Fortunately, both are receiving attention. Unfortunately, the clamor, litigation, and publicity over the mortgage situation resulting from the past is tending to mask the really solid thought being put on the problem of finding means of attracting capital on terms honest to both lender and borrower. We are almost certain to see revived interest in lending soon and almost equally certain to see it done under new plans which will eliminate the worst features of the old. Building cannot really go ahead until there is a real clarification and a sound new plan. The interests of all in this industry are intimately affected by this subject. Even now tentative proposals and tentative plans are being brought forward. They are well worth closest attention.

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A Census of Heating Plants

WHEN results from the CWA Inventory of Real Property become available in the near future, we ought to know something about the details of the real estate situation. There has been so much confused information put out in recent years that authentic information is really badly needed. We have been solemnly assured that there is a terrific over-supply of office-building space, and equally solemnly told that there is no such thing—in fact, that there is a shortage. Much the same kind of conflicting information has appeared regarding other classes of buildings. The degree of correctness seems to vary with the interests of the reporting parties and with the adequacy of their machinery to collect the facts. The government should have no special interest and has adequate machinery. Real facts, therefore, should come from this inventory. For the first time we will know definitely how many buildings use steam, hot water, or warm air, and how many use the several kinds of fuel. It is unfortunate that at the time plans were being made for this survey no one was prepared to urge successfully the necessity for still more detailed facts about the mechanical equipment.

BUSINESS BRIEFS

Business conditions showed continued improvement in January, and some gains were extended into the first part of February. Striking among the improvements in basic industries during February were those in the automobile and lumber businesses.

To those interested primarily in the building end of construction, the general news releases are often misleading. This is particularly true of recent months, when the gains in heavy construction, such as highways, dams, and similar projects, are causing the total contract-awarded figures to rise sharply.

New building alone, as shown in the accompanying graph, at least maintained in January the previously made advance. Declines took place in residential building, the drop amounting to 30%. Other losses were in social and recreational building, 50%; public building, 40%, and hospital and institutional building, 50%. On the other hand, gains included those in commercial building, 50%, industrial building, 50%, and educational building, 25%. Religious and memorial building held about the same as in December. The percentages are for January as compared with December.

While the drop in heating business in December, as reflected by Heating and Ventilating's Index of Heating Business (see next page), was disappointing, the building gain started in December should make itself felt in the January figures. The continuance of the building volume in the January reports indicates that heating business in February, March, and April should pick up noticeably.

Smaller factory units in the future were predicted recently by Walter Kidde, president of Walter Kidde Constructors, Inc., at a meeting in New York. Rapid changes in industrial methods, he expects, will force types of construction on which the cost can be written off quickly, before the structures become obsolete.

Minneapolis-Honeywell Regulator Company anticipates increased sales volume in 1934, according to C. B. Sweatt, vice-president in charge of sales. 1933 business increased more than 23% over 1932.

Good news for equipment men selling the theatrical field is found in reports that RFC is considering a loan of $5 million for rehabilitation of theaters. According to Bernard Levey, president of the Theatrical Finance Corporation, which is seeking a loan, there is a tremendous interest in the old-fashioned road shows, but the theatrical properties over the country, in which millions of dollars are tied up, cannot be opened up until the theaters are modernized.

There is a shortage of single-family houses in 27% of the 273 cities surveyed recently by the National Association of Real Estate Boards. There is also a shortage in apartment space in cities of less than 100,000 population.

The condition of shortage appears to be more prevalent in smaller than in larger cities, but no city of more than 500,000 population reported an oversupply of smaller houses, and 14% of that group showed a shortage. The Board reports continuation of the non-existence of mortgage money.

January sales of Timken Silent Automatic oil burner and oil boilers showed a 42% increase over January, 1933, and the company states that the outlook is extremely favorable for February and March.

The PWA has loaned the Juniata Park Housing Corporation of Philadelphia $1 million for construction of a low-rent model housing project in the Kensington district. The house, which will contain 248 apartments with 1084 rooms, will be built by the limited dividend corporation formed by the American Federation of Hosiery Workers.

Home Owners Loan Corporation on February 7 adopted the principle that heating repairs and improvements to homes financed by its money should be carried out in such a way as to eliminate air pollution as far as possible. The decision followed receipt by James H. Fahey, head of HOLC, of a communication from H. B. Meller, in charge of air pollution investigation at the Mellon Institute of Industrial Research, and I. B. Sisson, senior fellow in smoke abatement of the Institute.

The letter urged the framing of regulations to insure the installation of smokeless and dustless equipment in all renovations financed by federal funds to prevent a threatening of the "integrity of the investment."

The number of customers who use gas for building heating increased 30.5% in November from November a year ago, according to Paul Ryan, chief statistician of the American Gas Association. The figures apply only to manufactured gas territories.

Although both Minneapolis and Duluth building showed a decline in 1933 from 1932, St. Paul, Minnesota's second largest city, showed a gain of 73%.

R. J. Hamilton, president of the American Radiator Company, is among the members of a committee in charge of the Real Estate Inventory being conducted in New York. A total of 5400 CWA workers are employed in the survey, which is a joint project of the City of New York and the Department of Commerce.

Robert B. Beach has been appointed secretary of the National Association of Building Owners and Managers, succeeding L. B. Ermeling, who has joined the hotel code authority.

Sir Raymond Unwin, British authority, in a recent address pointed out that in England and Wales, it was found that, over a period of 20 years, housing was being erected at two or three times the rate of population increase. Investigation showed

that this was due to the fact that population had increased only 11% but the number of families had increased 38.8%. Sir Raymond declared that the same thing is going on in America and that the increase of population of 16% as compared with the family increase of 23%, results in a handsome present for real estate men and builders.

A COCKTAIL room to be added to the Hotel Mayflower in Washington, D. C., will cost $42,000, of which $10,000 will be spent for a complete air cooling system.

LOS ANGELES leads Pacific Coast cities in volume of building permits issued during January.

A MEETING of the Board of Directors of the National Association of Real Estate Boards was called for March 1 in Washington for action upon the NRA Code for Real Estate Brokers.

OPERATING costs for office building heating and ventilating plants, in cents per square foot, range from 6.5 to 8.3 cents, according to the National Association of Building Owners & Managers. The figures are averages, the higher being the average for 1929 and 1930, the lower that for 1932.

ON January 1, 1934 the Air Reduction Company, Inc., exercised its option on the balance of the capital stock of the Wilson Welder and Metals Co., North Bergen, N. J. Air Reduction thus becomes the first of the oxy-acetylene welding companies to own a 100% interest in an electric welding organization.

COL. HORATIO B. HACKETT, Chicago architect-engineer, has been placed in charge of the Public Works Emergency Housing Corporation. This agency has been allotted $100 million for slum clearance and housing projects.

Colonel Hackett has been superintendent of building construction for Holabird & Root. He is also a famed football referee.

CALIFORNIA will require 40,000 new residences a year, according to Harrison R. Baker of the California Real Estate Association.

THE Roosevelt Administration's policies on hydro-electric power were assailed by C. B. Huntress, executive secretary of the National Coal Association, speaking before the American Institute of Mining and Metallurgical Engineers recently. "Persistence in the hydro-electric program will go far toward ruining the coal industry," said Mr. Huntress.

ABOUT 65% of the leading colleges and universities in the country are in definite need of new buildings or additions and rehabilitation of existing structures, according to a survey conducted by the Hegeman-Harris Company, New York builders.

The survey, based on reports from leading educators in 35 states, and taking in 221 institutions, listed only 11% as having adequate buildings. About 24% did not furnish complete information.

The most urgent need was said to be student housing, one in four of the reporting schools listing their dormitory facilities as inadequate.

Libraries were listed as second in importance, and next in order came fine arts buildings, gymnasiums, and classroom buildings. Needed construction for which estimates were made amounted to $93 million, and using average costs for needed buildings where no estimates were given, the aggregate need of the schools in question was set at $135 million.

In more than one report extravagant building in the past was deplored as having prevented reduction in tuition costs at a time when such cuts would be a decided advantage.

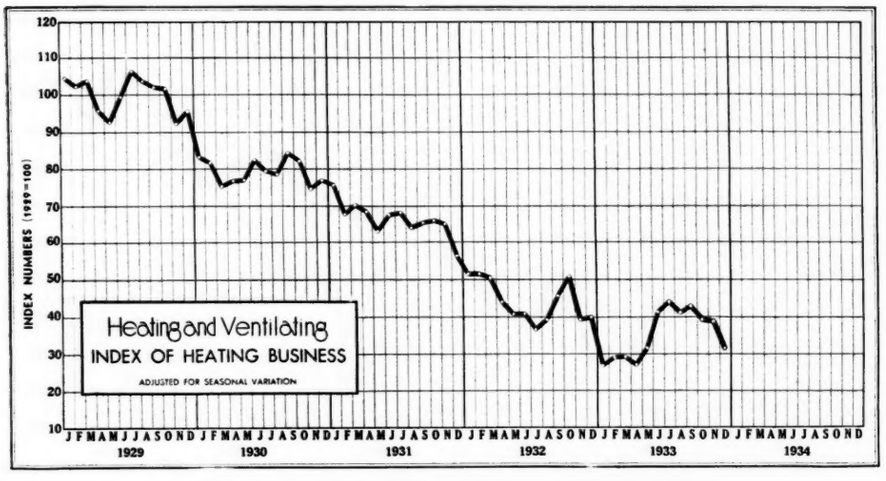
DETROIT is anticipating a revival of building. According to Edwin Krieghoff, president of a general contracting firm of that name and President of the Builders' and Traders' Exchange of Detroit, "Everyone feels confidence in the repeated statements that Detroit's main industry is headed for bigger production. It seems self-evident that with increase in operation of the automobile industry there will be a gradual taking up of the slack in the building business of this city. What we need is a source for mortgage money."

A WASHINGTON letter reports that labor union complaints from business men are more numerous regarding building trades unions than for any other group.

THE 1933 sales of Kewanee Type R boilers for homes and smaller buildings exceeded those of 1932 by 112%.

OF the 11,416 stokers sold for heating plants in 1933, 9,507 were residential types.

IN spite of all the talk years ago about using cement blocks for


INDEX NUMBERS (1929=100)
120
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Heating and Ventilating
INDEX OF HEATING BUSINESS
ADJUSTED FOR SEASONAL VARIATION
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HEATING BUSINESS DOWN IN DECEMBER

Activity in the heating industry, as indicated by HEATING AND VENTILATING'S Index of Heating Business, declined in December to 31.5% of the 1929 average from 39.0 in November. The decline was uniform over all the components which make up the index with one exception. Radiators, cast-iron boilers, and oil burners all showed a decline greater than the usual seasonal drop. Steel boiler sales, however, increased in the face of a normal seasonal decline.

houses, the subject gradually passed into oblivion and has been little mentioned since, even in connection with standardized houses. Now, however, G. W. Gill, Dallas achitect, proposes greater use of concrete for houses. Such buildings, he claims, have advantages in weight, through the use of a new aggregate, and says that such houses are cooler in summer and warmer in winter.

School building is expected to show sharp gains in Delaware, Pennsylvania, and New Jersey — good news for contractors and material men in those territories. Delaware will be the most active this year. For some months it has had plans in progress for additions to schools in virtually all parts of the State.

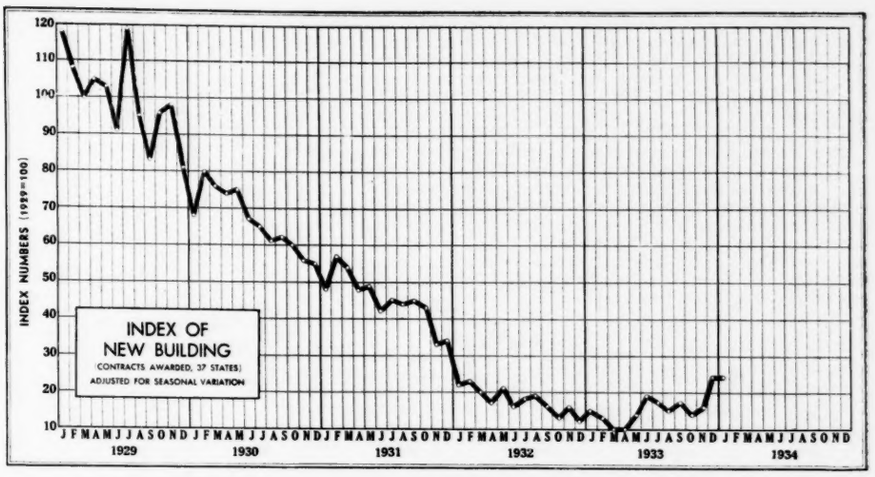
School construction in South Jersey will be fair, although the volume cannot be compared in any respect to Delaware's program. There are several schools contemplated for Camden County, with other structures to be built in the far eastern part of the State, and possibly in the southern section.

According to the Bureau of Labor Statistics there was a decrease of 31.5% in the number of buildings, but an increase of two-tenths of 1% in the value of buildings for which permits were issued during December, as compared with November.

Between November and December there was a decrease of 36.8% in the number and a decrease of 46.9% in the estimated cost of new residential buildings for which permits were issued. The number of non-residential buildings for which permits were issued decreased 39.8%. The estimated cost of these buildings increased 33.6%.

Automatic Burner Corp., Chicago, announces that its burners will be distributed as package products through home appliance dealers.

Renting of gas-steam radiators is possible if you are on the lines of the Pawtucket (R. I.) Gas Company. This scheme has been tried out for two years, according to C. S. Hilton, house-heating engineer of the company. Rent runs from 78 cents to $1.57 per month, depending on the size of the radiator, rent being charged for only eight months of the year.



NEW BUILDING HOLDS AT PREVIOUS LEVEL

New building contracts in 37 states, as reported by F. W. Dodge Corporation, held in January at the level reached in December—24% of the 1929 average. The index is adjusted for seasonal variation. There was a small drop in the value of the awards, but the drop was of the same extent as the usual seasonal decline, so that the index remains at the December figure.

1933 Annual Reports

Iron Fireman Manufacturing Company and Subsidiaries: Net profit after depreciation, Federal taxes and other charges, $330,784, equal to $1.68 a share on 196,305 no-par capital shares, compared with $78,679, or 40 cents a share, in 1932.

Motor Wheel Corporaton had a net profit in 1933 of $22,122, as compared with a 1932 net loss of $1,186,751.

Modine Manufacturing Company: Net profit after Federal taxes, depreciation and other charges, including $45,251 loss on sales of securities, $60,959, equal to 61 cents a share on 99,349 no-par common shares, excluding treasury stock, contrasted with net loss of $165,652 in 1932.

Mueller Brass Company and Subsidiaries—Year ended November 30: Net income, $29,060, equal after preferred dividend payments to 6 cents a share on 143,104 common shares, contrasted with $309,851 loss in preceding fiscal year.

Holland furnace reports for the quarter ended December 31 a net profit of $16,404 compared with a net loss of $398,671 in the 1932 last quarter.

Permission to float securities has been asked by the Housing Corp. of America to the amount of $2.5 million. . . . "Electric" wallpaper, which has resistance coils inside, developed in England for radiant heating, comes in rolls a yard wide and 1/25 in. thick . . . Radio City has a rival in Russia . . . It will be on the Miusskaya Pioshchad, Moscow, and will seat 10,000 . . . Being open air, it will need no heating.

Building Contractors Employers Association, New York, approves the new NRA building code . . . So does the president of the National Association of Real Estate Boards, Hugh Potter . . . One humorist says the public doesn't demand speed on railroad trains . . . All they want is a 75-cent dinner, a little ventilation, and assurance that the fellow across the aisle won't take his shoes off.

A Washington architect wants owners of 800,000 homes to spend $100 each on modernizing, giving the building industry a staggering total of business . . . A swell idea, but if they spent $200 apiece it would make still more business . . . If plumber jokes amuse you, read *Les Plombiers Francais* in the March *Esquire* . . . The much publicized Home of Tomorrow is an all-electric house . . . Except for the heating, which is oil . . . Portland Cement Association believes flat roofs are coming . . . That would scrap all the nice data just completed on attic cooling fans.

NEWS OF THE MONTH

Burner Men Ready for Show, Convention

With a full week's schedule of merchandising, engineering, and business meetings arranged, and a large number of burner and accessory manufacturers contracting for exhibition space at Philadelphia's Commercial Museum, the oil heating industry is enthusiastically completing its plans for the 11th annual National Oil Burner Show and Convention of the American Oil Burner Association, to be held March 5-9 in Philadelphia. The Benjamin Franklin Hotel will be convention headquarters. About 80 exhibitors will display their products at the exposition.

Meetings of the various committees and executive groups will occupy the first two days of the convention. Wednesday, March 7, has been designated Dealer Day, and will include a merchandising session in the morning, and meetings of the Manufacturers Division and the Dealers Division in the afternoon. All dealers, member and non-member, are cordially invited to attend the latter meeting, and are urged to take part in the discussion. The engineering session is scheduled for the morning of Friday, March 9.

School Ventilation Amendments Proposed Again

Companion bills proposing amendments to Section 451 of the Education Law, covering ventilation requirements for school buildings, have been introduced in the Assembly and Senate of the New York State Legislature.

As provided by the amendments, plans for school building, erection, addition, or remodeling, to be approved, must include provision for means of mechanical or gravity ventilation for each study or recitation room which shall in the judgment of the commissioner be adequate to maintain healthful conditions in the schoolrooms. This proposed amendment would take the place of present clauses requiring the provision of at least 30 c.f.m. of fresh air for each pupil, and specifying that the facilities for exhausting the foul or vitiated air shall be positive and independent of atmospheric changes.

Forced Air Course at Michigan College

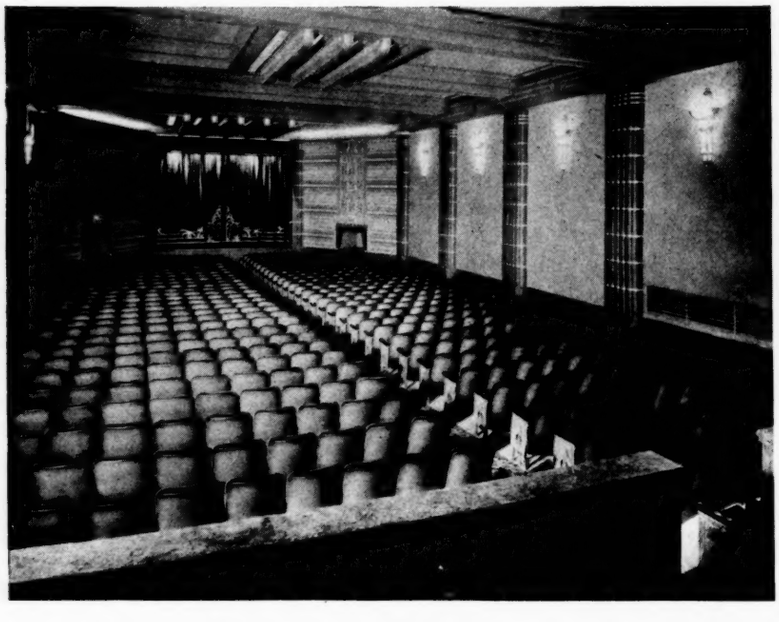
Michigan State College, East Lansing, Mich., has scheduled its annual short course in forced warm-air heating and air conditioning for March 26-28. The course, planned primarily to cover the elementary phases of the subject, will follow the complete design and layout of a residential forced-air system from start to finish. Specialists will lecture and demonstrate in the methods of design, air cleaning and washing, location of registers, air velocities, automatic controls, combustion problems, conversion jobs, and summer cooling.

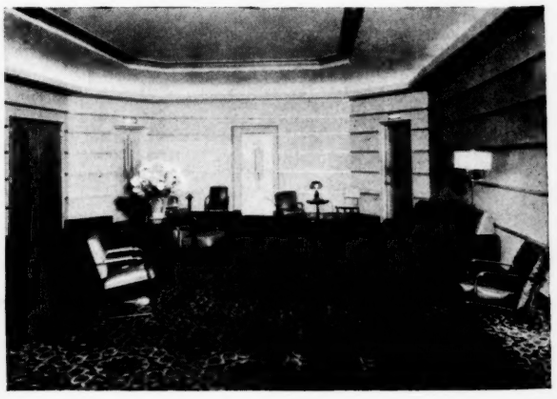
Those interested should communicate with the registrar of the college. A nominal registration fee is charged.

Oil Burner Code Violations Referred to Washington

A selected group of violations of the NRA code for the oil burner industry has been referred to the Administrator's office in Washington to enforce compliance according to the procedure that has been developed by the NRA, it was announced by the Oil Burner Code Authority in New York, February 13.

These cases, it was explained, are in various stages ranging from a compliance action through the Deputy Administrator's office to the preparation of action by the legal division of the enforcement section





Architect, Raymond Irrera

Small, modernized, air-conditioned theaters which show second-run movies at low prices have appeared in large numbers recently. Interior views shown are of one of these — the Carlton — in New York, owned by the Springer-Cocalis circuit, with 35 similar houses

of NRA to carry out enforcement procedure provided for in the National Industrial Recovery Act.

All of these may be regarded as test cases having no precedent thus far. Consequently, it was stated, action on these may be relatively slow but once the principles incident to them are established, future cases of a similar nature will be handled with considerably more facility.

General trade practice violations handled by the Code Authority up to the middle of February total 224 cases, 207 of which have been satisfactorily adjusted and compliance obtained. Seventeen cases remain pending, while 137 cases have been given interpretation with respect to labor, prices, levies, etc. Sixteen cases, where companies have applied for exemption to operate under another code, have also been adjusted, bringing the total number of cases handled to 377.

In the matter of inter-industry competitive practices, and particularly those practices during the past year on the part of certain utilities in the Chicago area, the Code Authority, on behalf of the oil burner industry, played a signal part in bringing about further consideration of the Natural Gas Code in the matter of inclusion of fair trade practice regulations which that code, as originally presented at public hearing, did not contain.

New Instrument Company Formed

Wilbin Instrument Corp., 40 East 34th St., New York, has recently been formed to manufacture and market a complete line of electric instruments for controlling temperature, humidity, pressure, vacuum, and liquid levels, in the heating, air conditioning, refrigeration, and process industries.

Officers of the new company are: President, Gus A. Binz; vice-president, Clement Wells; director and chief engineer, E. A. Ileman. Mr. Wells is also president of Sarco Co., Inc., New York.

The company has made manufacturing arrangements with Crosby Steam Gage & Valve Company, Boston.

Timken Appoints Roberts

The Timken Silent Automatic Co., Detroit, has appointed Millard J. Roberts general sales manager and elected him to a vice-presidency.

Mr. Roberts for four years was president of the Roberts-Gordon Appliance Company, and for the past year was associated with the American Radiator Company in the development of heating appliances.

Pratt to Extend A.C. Courses

Pratt Institute, Brooklyn, N. Y., is planning to extend its courses in the field of heating, ventilating, refrigerating, and air conditioning engineering if a sufficient number of students are interested, according to an announcement by R. B. Dale, supervisor of the course in Industrial Mechanical Engineering. It is proposed to form the new classes to meet on Saturdays, either morning or afternoon, or on Monday, Tuesday, and Thursday afternoons from 4 p.m. to 6 p.m.

The work of the present evening courses consists of recitations and laboratory exercises in elementary and advanced theory and design for both comfort and commercial process work. Advanced work encompasses laboratory performance tests, determination of air flow constants, heat transmission coefficients. radiator tests, etc.

Marsh Appoints Kane

Jas. P. Marsh Corp., 2073 Southport Ave., Chicago, announces the appointment of J. M. Kane, P. O. Box 1552, Fort Worth, Tex., as sales representative.

American Radiator Organizes Air Conditioning Division

A special air conditioning division has been formed by the American Radiator and Standard Sanitary Corporation to assist the component companies of that organization in coordinating their work in this field, Clarence M. Woolley, chairman of the board, has announced.

"Air conditioning, as a business," Mr. Woolley said, "can best be developed by utilizing the knowledge and experience of the heating and plumbing trade, and it will be one of the functions of the new division to aid the component companies of the corporation in making the fullest possible use of this knowledge and experience."

The director of the new division will be Fowler Manning, who has had extensive experience in developing and directing large marketing organizations. Associated with him will be George Atherton, who has been assistant general manager of sales of American Radiator Company, and Frank B. Stubbs, who has been in charge of the corporation's Bureau of Air Conditioning, during the preliminary work that has preceded the formation of the new division.

In discussing the work of the new air conditioning division, Mr. Manning declared that air conditioning equipment must be taken out of the "gadget stage" and developed as part of the integral equipment of a building. "Inasmuch as air conditioning is an extension of heating and ventilating," he continued, "our first resolution is that heating and the heating trade shall be the beneficiaries of this new market. The American Radiator and Standard Sanitary Corporation is broadening its activities to take the leadership in this field, and we are confident that in cooperation with heating and plumbing contractor-dealers and others who have cooperated with us in the past we can develop air conditioning as it should be developed for the benefit of the public."

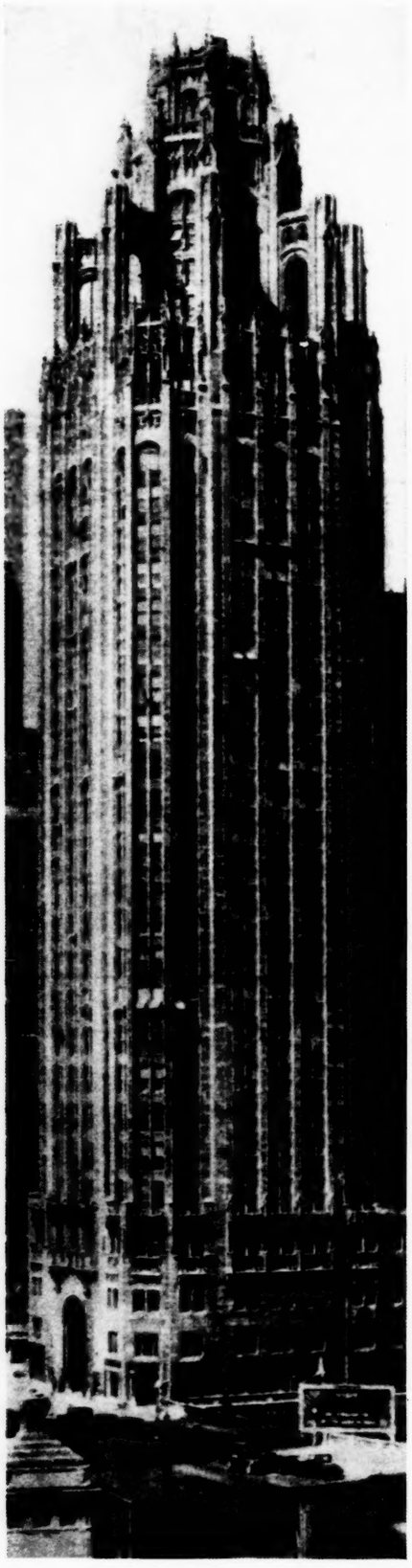
Mr. Manning was formerly president of L. C. Smith and Corona Typewriters, Inc. Before he became president of that company in 1928, he was director of sales for the Hoover Company, manufacturing vacuum cleaners, for five years, and before that he was director of sales for the Diamond Match Company.

Mr. Atherton has been connected with the American Radiator Company since 1909, having first been connected with the Cincinnati office

(Continued on page 56)

Picture Paragraphs

↑ WORLD'S LARGEST THERMOMETER, built by Brown Instrument Company, registers outdoor temperatures on Atlantic City's boardwalk. The insert shows the comparative size of the pointer. The thermometer is accurate to one-quarter of a degree.



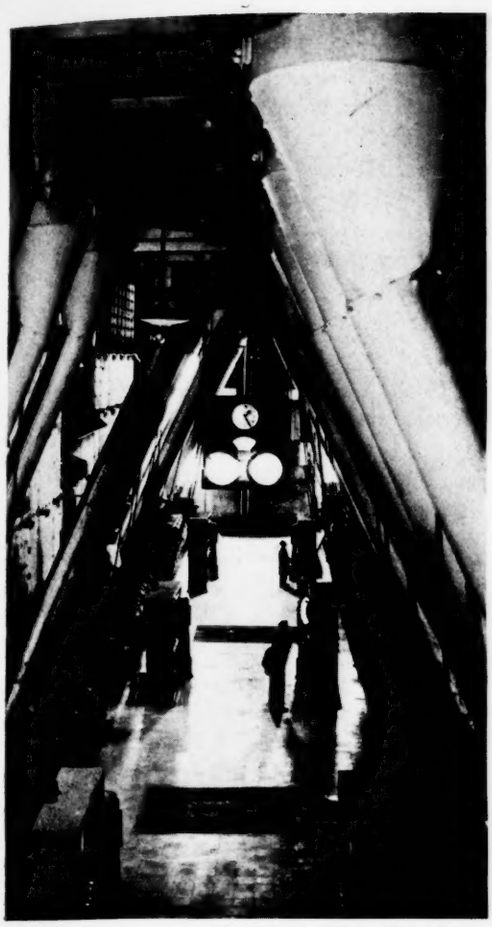
Keystone View

14° BELOW ZERO is what this recording thermometer is registering. H. Merrill Wills, of the New York Weather Bureau, is examining the telethermograph on the Whitehall Building, February 9. That morning New York Steam Corporation sent out 6,927,000 lb. of steam in 1 hr., largest in the corporation's history. ↑

AN ELECTRIC GREENHOUSE: ⟶ Electrically-heated hot bed developed for home gardeners is automatically controlled. This bed uses 54 to 145 kw-hr. per month.

Peter Henderson

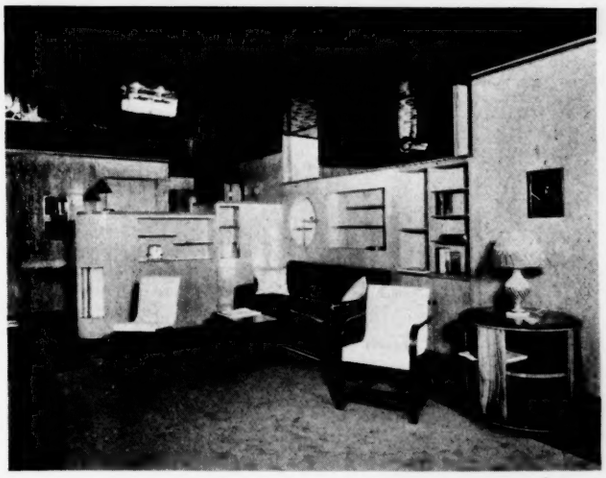
⟵ LARGEST UNIT TYPE air conditioning installation is being made in the Chicago Tribune Tower. A 600-ton steam jet plant serves 400 room units.



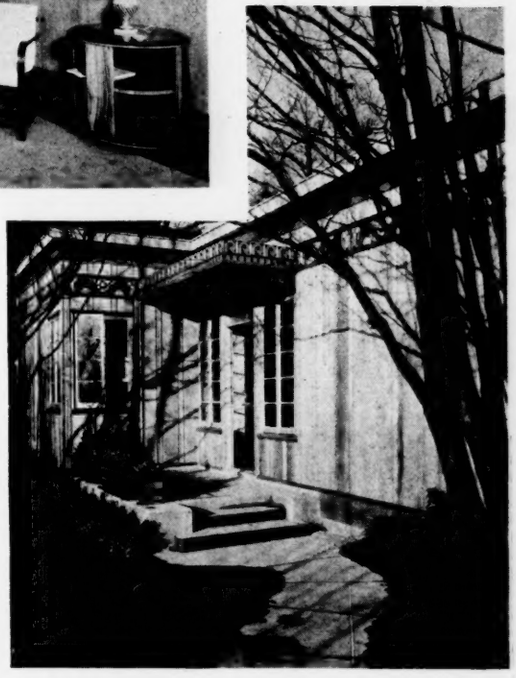
International News

↑ ROBOT POWER PLANT in Barking, Essex, England—an almost automatic power plant, largest in British Isles. Tubes are fuel feeders for boilers.

↑ A TORTURE TEST set up for varying temperatures and humidities in testing gas engines. Temperature variation of 150° in 2 min. fails to reduce the output of the engine.



↑ MODERN INTERIOR of the Weyerhaeuser pre-fabricated wood house, located in Seattle and opened to the public in February.



↑ PRE FABRICATED HOUSES of metal are not uncommon. Here is one of the first made of wood, pre fabricated at the mills of the Weyerhaeuser Timber Co., Tacoma, Wash. Units were transported to the site in the form of panels. House was completed in 21 working days in spite of bad weather.

International News

← CHICAGO IS PROUD of Eddie Schroeder, ice skating speed champ, shown here firing a heating plant two floors below Michigan Boulevard, training for North American championships. He won.

of the company. Later he was in the Chicago office until he was made manager of the Detroit branch. Since 1932 he has been assistant general sales manager at New York in the concealed radiator division.

February Breaks Weather Records

As this issue goes to press we are approaching the end of a winter that has few equals in the records of the U. S. Weather Bureau. The months of November and December averaged somewhat colder than usual. In January, snowfall was a negligible quantity in all parts of the United States, while the temperature, excepting the last three days, averaged from 3° above normal at Boston to 10° above at Chicago. The cold wave that swept the country January 28-29 lowered the mercury to near or below zero in many parts.

February records to date indicate no recovery from that shock. On the contrary, it became established about the middle of the month that February, 1934, would pass into record as the coldest ever. This will be seen when records are complete. At any rate, it is interesting to note two heavy snow storms and one severe cold wave.

On February 20 an average depth of 9.2 in. of snow was measured in the city of New York. This paralyzed industry for several days, during which time 50,000 men were put to work at snow removal. The storm was also severe at Washington, Philadelphia, Atlantic City, and Boston.

The storm near the end of February was widespread, being attended by destructive tornadoes in Mississippi and Alabama, and snow which was heavy in many states from Texas and Oklahoma to the coast from North Carolina to Maine. Cities in the East again became snowbound. Where last winter there was a surplus of coal, a shortage is now felt.

Early in February, Lake Ontario became frozen over. One cold wave after another since January 28 made it possible for the record breaking temperature of 14° below zero on the 9th at New York and 17° below at Boston.

One effect of such low temperature is reported in the contraction of metals of the George Washington Bridge between New York and Jersey City, the span of which, lifting 34,700 tons of concrete, was raised at center 3 ft. above its usual height.

The winter of 1917-18 was colder than this winter over a longer continuous period. December of that winter averaged 9° below normal at all the stations charted in this publication each month, and 11° below in January. All the Great Lakes were frozen over; St. Louis, Chicago, and Pittsburgh being much colder than New York and Boston. The shipment of coal in the West as well as in the East became a serious problem. Governor Smith appointed two coal administrators in order that fuel might be equally distributed throughout New York City and State—and New England.

Randolph New Sales Manager at International

H. F. Randolph, formerly assistant sales manager, has been made sales manager and also director of the International Heater Co., Utica, N. Y. Mr. Randolph succeeds L. R. Taylor, who continues as vice-president of the company.

I. C. Barber, formerly New England representative of the company, has been made assistant sales manager.

Youngstown Adds to Equipment

The Youngstown Sheet & Tube Co., Youngstown, Ohio, is installing a Steckel mill in conjunction with its universal plate mill in its Indiana Harbor works, Frank Purnell, president of the company, announced in February. The mill will produce coiled strips for cold rolling into tin plate.

A banquet followed the session of the "field clinic" conducted by the Minneapolis-Honeywell Regulator Company in Chicago, January 24. Similar clinics bringing the home office to the field were held also in Toronto, Boston, Philadelphia and New York.

Rome Radiation Appoints Kitson

Rome Radiation Division of Revere Copper and Brass Inc., Rome, N. Y., has appointed John E. Kitson, 214 Johnson Ave., Teaneck, N. J., sales representative of Revere convectors in the northern portion of New Jersey, and in Rockland County and Staten Island, New York.

Lippmann Resigns

Frederick M. Lippmann has resigned his position as sales manager for Youngs Cornell Utilities, Inc., Delco distributors in Rockville Centre, New York. He has not as yet announced future plans.

Railway Express Service 95 Years Old

March 4 marks the 95th anniversary of railway express service in the United States, according to an announcement of the Railway Express Agency, Inc., an organization which today renders invaluable services to shippers of goods all over the country. This great industry, the outgrowth of an idea conceived in 1839 by William H. Haraden, conductor on an early New England railroad, is now owned by the principal railroads of the country, and operates over 225,000 miles of lines, has offices in 23,000 principal cities and towns, and employs more than 50,000 men and women in its operations.

Mason-Neilan Transfers Church

Donavon B. Church has been transferred from the San Francisco branch office to the factory engineering department by the Mason-Neilan Regulator Co., Boston.

Adams New Sales Promotion Manager for A. R. Co.

Marshall Adams has been appointed sales promotion manager of the American Radiator Company. Formerly sales promotion manager of the merchandising department of

Marshall Adams, new sales promotion manager of American Radiator Company

Westinghouse Electric and Manufacturing Company, Mr. Adams was connected with the latter company since 1923.

Max D. Rose, assistant general manager of sales, has been made eastern sales manager for the American Radiator Company, and D. E. Kennedy, vice-president with headquarters in Chicago, has been made western sales manager.

Plumbers to Meet in Washington

Washington, D. C., has been selected for the 52nd annual convention of the National Association of Master Plumbers, to be held May 28-31, 1934 at the Washington Auditorium.

Chicago Utility Surveys Conditioning Jobs

Air conditioning installations in Chicago number 410, according to a survey of this equipment recently completed by the air conditioning department established by the Commonwealth Edison Company as a part of its service to prospective users, manufacturers, and contractors. The city has 63 air conditioned restaurants, and 48 completely and 22 partially conditioned theaters. Equipment for year 'round operation is installed in 53 private offices or suites, and industrial and manufacturing installations number 73.

Residential installations were found to be few in Chicago, more numerous in the suburbs. Gaylord A. Freeman directs the utility company's air conditioning department.

Carpenter with Commerce Dept.

Charles A. Carpenter, Pittsburgh, Pa., has been appointed acting district manager of the office maintained in that city by the Bureau of Foreign and Domestic Commerce of the U. S. Department of Commerce.

Mr. Carpenter, long experienced as engineer and salesman with a firm of manufacturers' agents, is the author of numerous technical papers and articles, among which are "Some Suggestions for Specification Writers," and "Fan Selection," published in 1932 issues of HEATING AND VENTILATING.

Fleisher Talks on Heat Pump

Walter L. Fleisher, consulting engineer, addressed the regular monthly meeting of the New York Chapter, A.S.H.V.E., February 19. The subject was the "Heat Pump and the Measurement of Its Economy."

Mr. Fleisher emphasized a number of points, among which were that a reversed refrigeration system designed for summer cooling was not capable of carrying the entire heat load in northern climates when the temperature dropped below fairly cold points. On the basis of calculation for an ordinary residence using a 3-ton refrigerating machine, Mr. Fleisher showed that, under the conditions he assumed, the heat pump would be unable to heat the building when the outdoor temperature became colder than 35°. The speaker pointed out, however, that the system was applicable to southern climates.

Inasmuch as this system is used for both cooling and heating and the fuel is electricity, the power cost must be below 1 cent per kw-hr. For example, in the case of the machine used by the speaker to illustrate his problem, 0.7 cents per kw-hr. electricity would be equivalent to coal at $35 per ton. Mr. Fleisher said that although a heat

pump could be used in southern climates, even there the application is limited, because in such states as Oklahoma, Texas, and Louisiana, while the outdoor temperatures never get low, nevertheless oil and gas costs are so cheap that the competitive situation is still of paramount importance.

New Revere Appointments

Revere Copper and Brass Inc., 230 Park Ave., New York, announces that J. A. Doucett, formerly vice-president and general sales manager, has been appointed vice-president in charge of sales, and C. A. Macfie, formerly assistant sales manager, is now general sales manager.

Headquarters of both Mr. Doucett and Mr. Macfie will be at 230 Park Avenue, New York.

Contractors Appoint Code Representatives

At the meeting of the Board of Directors of the Heating, Piping and Air Conditioning Contractors National Association, held January 6-7 at Atlantic City, N. J., the following were elected to represent the association on the Code Authority; M. J. Chagnard, Louisville; J. Lawrence DeNeille, St. Louis; George H. Dickerson, Chicago; Walter Klie, Cleveland; Thomas O'Callaghan, Boston; Robert D. Williams, New York, and John R. Zink, Baltimore. This group will administer the Code of Fair Competition for the Heating, Piping, and Air Conditioning Division of the Construction Industry.

25 Years Ago in

The Heating Ventilating Magazine

MARCH, 1909

H. W. JOHNS MANVILLE COMPANY suffered a loss of $200,000 February 13, when its branch warehouse in Milwaukee, Wis., was destroyed by fire. Plans have been prepared for a new building.

AMERICAN RADIATOR CO., Chicago, will build an addition to its Pierce plant in Buffalo, to be occupied as a storehouse.

RICHMOND, IND. Plans are being prepared by local capitalists to establish a central hot water heating system in Richmond at a cost of $500,000. It is planned to commence work in the spring.

THE RICHMOND ACADEMY OF MEDICINE has adopted a series of resolutions calling attention to the dangers of asphyxiation from the products of combustion from unvented gas and oil stoves in sleeping rooms, and to use its influence towards acquainting the public with the hazards and warning them against the use of these appliances in bedrooms and living rooms.

PERRY WEST addressed the A.S.-H.V.E. on "A Rational Formula Covering the Performance of Indirect Heating Surface."

EDWIN H. ROBERTS, president of Standard Steam Specialty Company, died.

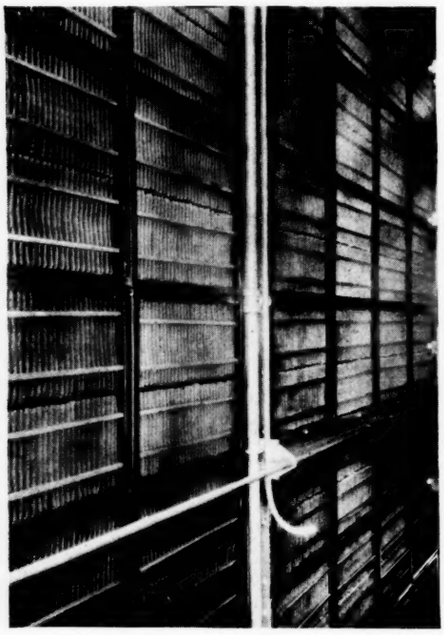
Columbia Not Studying Ventilation

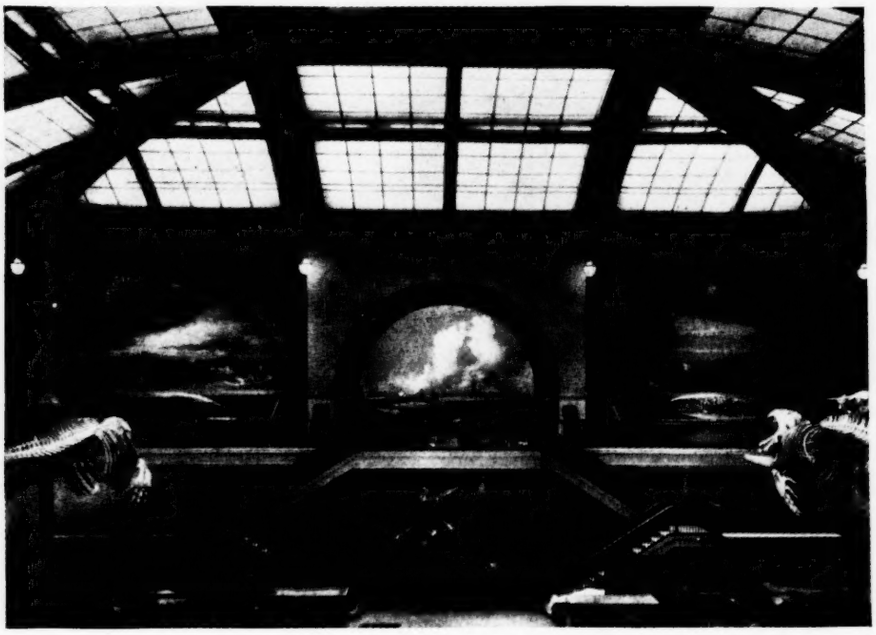
A misleading news item recently appeared in New York newspapers stating that Teachers College, Columbia University, had published a report on a three-year survey of school ventilation, showing that useless mechanical ventilation was costing taxpayers wasted millions. This news item was found to be incorrect.

According to a statement by Doctor Sayer of Teachers College, the report referred to is merely a reprint of the final report of the New York Commission on Ventilation, published about four years ago.

Offner Addresses Agriculturists

Alfred J. Offner, consulting engineer, New York, presented a paper, "Air Conditioning a Farm Build-





Specimens of fish, whales, seals, and other exhibits in the Hall of Ocean Life and the African Hall of the American Museum of Natural History, New York, are kept clean by Staynew dry-type filters, shown to the left. The other view shows the Hall of Ocean Life.

ing," before a meeting of the American Society of Agricultural Engineers, Harrisburg, Pa., January 18. Mr. Offner's paper described and illustrated a most modern farm building ventilating system.

Conditioning Course Started

A comprehensive evening course in air conditioning started January 31 at the Polytechnic Institute of Brooklyn, Brooklyn, N. Y. The course, consisting of thirty 1½-hr. sessions, meeting Wednesday and Friday evenings from 6:15 p.m. to 7:45 p.m., will cover such topics as theory, practical application, loads and load factors, calculations and design, and refrigeration theory and apparatus. John Everetts, Jr., of the department of mechanical engineering in the evening session, will be in charge of instruction.

The course is open to anyone engaged or interested in air conditioning work. Tuition is $35.

Carrol Baker Dotson

Carrol Baker Dotson, long associated with the Anthracite Institute, died suddenly of heart disease February 26 at his home in New York. He was in his fiftieth year.

Born in Des Moines, Mr. Dotson graduated from Drake University. He was later an editorial writer for the old New York Globe and the New York Herald. He wrote the course of study for the Newspaper Institute, a correspondence school, and was later connected with the Palmer Photoplay Institute.

Mr. Dotson is survived by his widow, a son, two sisters, and a brother.

Edward F. McElheaney

Edward F. McElheaney, assistant treasurer of The Central Foundry Company, New York, died February 17 at Muhlenberg Hospital, Plainfield, N. J., after a short illness from pneumonia.

Born 58 years ago in New Brunswick, N. J., Mr. McElheaney resided there and in Jersey City until he came to Cranford six months ago. He was associated with The Central Foundry Company for the past 32 years.

Widely known in trade credit circles, he was a member of the Jersey City Lodge of Elks and a Charter Member of the New Brunswick Council, Knights of Columbus.

His body was brought to St. Peter's Cathedral, New Brunswick, where Solemn Requiem Mass was celebrated by his cousin, the Rev. Arthur Hayes. Burial took place at New Brunswick. He is survived by his widow and sister.

COMING EVENTS

MARCH 5-9, 1934. Eleventh Annual Convention and Show of the American Oil Burner Association, to be held in Philadelphia. Exhibition and Convention Hall of the Commercial Museum to be the show site; Hotel Benjamin Franklin to be hotel headquarters.

MAY 28-31, 1934. Fifty-Second Annual Convention and Exposition of the National Association of Master Plumbers, to be held in Washington, D. C., at the Washington Auditorium.

JUNE 12-15, 1934. Twenty-Fifth Annual Convention of the National District Heating Association, to be held in Rochester, N. Y.

JUNE 19-22, 1934. Twenty-Eighth Annual Convention of the Smoke Prevention Association, to be held in Buffalo. Headquarters at the Hotel Statler.

JUNE 20-22, 1934. Spring Meeting of the American Society of Refrigerating Engineers, to be held in Skytop, Pa. Headquarters at the Skytop Club.

The American Brass Co., Waterbury, Conn., has issued a bulletin describing Anaconda copper tubes and fittings for water distribution, heating, and air conditioning lines. Includes complete engineering data on Anaconda cast bronze solder fittings together with instructions for fabrication; standard size, 22 pages.

Ilg Electric Ventilating Co., 2850 North Crawford Ave., Chicago, has issued a booklet, "Sensible Ventilation," describing and illustrating a wide variety of installations; standard size, 16 pages.

Struthers Dunn Inc., 126 North Juniper St., Philadelphia, has issued catalog B, describing Dunco relays, thermostats, electric counters, etc.

Indirect Heating Surface Statistics

EDITOR, HEATING AND VENTILATING:

Some of the statistical information given in your Annual Review and Summary in the January issue is, while probably correct, somewhat misleading. I refer to the data relating to Indirect Heating Surface.

The figures you published showed that 1933 sales of Cast-Iron Indirect Heating Surface fell sharply from those in 1932, while there was a gain in the figures for Non-Ferrous Surface. Figures for Blowers for ventilating work showed a drop of 49%, which indicates about what the drop was in Cast-Iron Indirect Heating Surface.

The reason for the gain in Non-Ferrous Surface was due to an increase in the cooling business. Non-Ferrous Indirect Surface is used for both cooling and heating, while cast-iron has been used only for the latter. Sales of Non-Ferrous Surface *for heating* dropped, I am informed, about the same as cast-iron. The net increase in the sales of Non-Ferrous Surface is therefore due to a large increase in use of this surface for cooling.

I suggest that the separation of the total figures for Indirect Heating Surface into subdivisions for Cooling and Heating would present a fairer picture than the indiscriminate grouping.

H. G. KREISSL

New York, N. Y.

The figures to which Mr. Kreissl refers are those reported by the Department of Commerce, which collects such information from manfacturers. The Department does not break the figures down into surface sold for cooling and that sold for heating, presumably because it does not receive them that way, and possibly because it may be difficult for the makers to break them down.

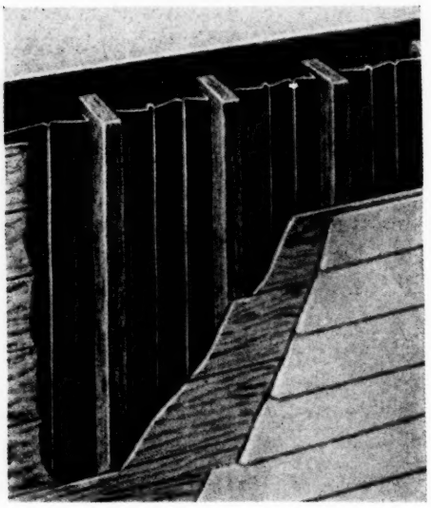
We agree with our correspondent that such breaking down is desirable, and we have suggested to the Department that an attempt be made to do this if it is possible and if they agree that it is advisable—EDITOR.

NEW EQUIPMENT

Steel Used for Insulation

American Flange & Manufacturing Co., 25 Broadway, New York, has developed Ferro-Therm metallic thermal insulation, utilizing commercial black steel, for general building construction, cold storage application, and similar uses.

This insulation consists of parallel spaced metallic sheets with dull surfaces, the sheets having low emission and high reflection coefficients at the frequencies of radiant heat. Thin sheets of commercial black steel are used, formed with angularly arranged surfaces with small ribs at the joints to secure rigidity and eliminate vibration and sound propagation. The manufacturer states that the number of sheets used in an insulated wall may be one or more, depending upon the temperature difference and the degree of insulation desired. The spacings between the sheets have been fixed by extensive experiments which have determined the arrangement best suited to eliminate turbulent air flow and to provide the highest thermal insulating value.



Ferro Therm applied to building construction

Insulation Is Waterproofed

Standard Lime & Stone Co., Insulation Div., Baltimore, Md., has developed a waterproofed rock wool insulation for use in locations where unusual moisture conditions prevail. Available in both the granulated and the commercial or loose forms, this new insulating material possesses a long tough fiber, and is said by the manufacturer to be particularly adapted to cold storage work.

Gleason-Avery Temperature Regulators

Gleason-Avery, Inc., 27 Clark St., Auburn, N. Y., is marketing a line of temperature regulating controls for residential coal-fired heating plants.

Damper control motor is enclosed in a grease-tight case and all moving parts are thoroughly lubricated. Switch contacts are of pure silver. A bakelite terminal board provides accessible wire connections. The manufacturer states that installation is simple and that operation causes no radio interference. The control is actuated by either a night-day dual thermostat, or a single thermostat, mounted in a polished chromium-plated cover and set by means of a radio type dial. No transformer is required in the hookup.

Removes Condensation Without Moving Parts

A radically different method for the removal of condensation from steam heating appliances and other steam-operated equipment has been announced by The Coe Manufacturing Co., Painesville, Ohio. The unit, known as the Coe Drainator, is compact in size and form. It contains no moving parts, and the manufacturer states that its operation is absolute and positive, utilizing the thermodynamic properties of hot water to regulate its own flow.

Return to the Drainator enters the receiving chamber, from which it passes through a baffled passage to an orifice, through which its passage to a re-evaporating chamber and the discharge is regulated. In normal operation, a pulsating action occurs with high frequency, maintaining an almost constant water seal, producing a continuous discharge of condensation from the Drainator. The presence of air in the discharge accelerates the rate of flow through the orifice, breaking the water seal for longer intervals, permitting the rapid removal of air and other non-condensable gases.

The device is said by its maker to be equally adapted to high- or low-pressure steam, and to possess a high overload capacity, permitting rapid starting-up. A gauge glass indicates the operation at all times, and air binding is said to be completely eliminated.

Coe Drainator

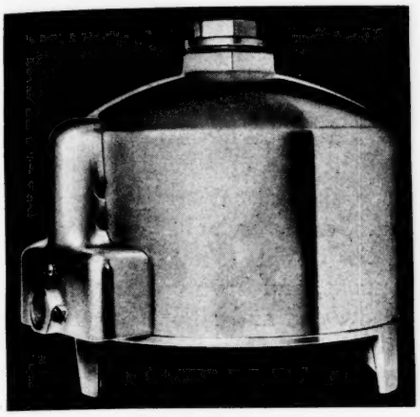
Controls Viscosity of Fuel Oil

Bell & Gossett Co., 3000 Wallace St., Chicago, has announced the B & G Viscostat, a device for automatically regulating the viscosity of the fuel delivered to an oil burner. The manufacturer states that by its use the less expensive heavier grades of fuel oil, having higher calorific values, may be burned efficiently without carbon deposit.

The unit is connected into the fuel line, and heat is applied to the oil by means of a thermostatically-controlled electric heating element.

This heating element is located beneath the process chamber, away from contact with the oil, the heat being conducted to the fuel through a radiating plate. The process chamber is an acid-resisting bronze casting, leakproof, and built to withstand an internal pressure of 400 lb. per sq. in. A self-cleaning strainer removes dirt and grit from the fuel as the heated oil rotates about it.

Two sizes are available, designated senior and junior, respectively, for burners up to 15 gal. per hr. and 5 gal. per hr. They are for use with any type of burner excepting wall flame and pot types.



B & G Viscostat

Delco Markets Boiler-Burner

Delco Appliance Corp., Rochester, N. Y., subsidiary of General Motors Corporation, is distributing the Delco Heat boiler, an automatic oil-fired unit for residential and small commercial application. It may be used with either steam or hot water systems, and incorporates a domestic water heater with winter and summer control.

Boiler is of the cast-iron sectional type, having extended surface fins to increase the heat transfer rate. These fins also serve as baffles to retard the passage of the hot gases to the flue.

Burner is of the pressure-atomizing type, using No. 3 fuel oil. The combustion air is preheated beneath the combustion chamber before being mixed with the atomized oil, a feature promoting rapid combustion and increased economy, according to the manufacturer. The unit is entirely encased in a furniture steel cabinet, trimmed in chromium, and finished in two tones of green. The combination is available in four sizes; capacities ranging from 600 sq. ft. to 1700 sq. ft. of steam radiator, and equivalent sizes for hot water.

Condensator Returns Water to Boiler

Barnes & Jones, Inc., 128 Brookside Ave., Jamaica Plain, Boston, Mass., is manufacturing the Condensator, a device for returning water to the boiler in steam heating systems having the return line open to the atmosphere. Operation is positive and independent of the boiler pressure, according to the manufacturer.

The device is installed close to the boiler, as high above the water line as possible. As the return water rises in the float chamber of the device, the float causes the opening of a valve between the boiler and the Condensator, equalizing the pressure in the boiler and the Condensator and allowing the water to return to the boiler by gravity. Check valves prevent the admission of steam to the return side of the system, and the water is returned to the boiler without any change in the operating conditions of the system or raising the pressure in the return. The air vent from the device is connected to the dry return, the air being discharged to the atmosphere through an air vent. Working parts are of durable bronze and are wholly enclosed.

This equipment is made in seven sizes, ranging in capacities from 700 sq. ft. to 32,000 sq. ft. of direct steam radiator.

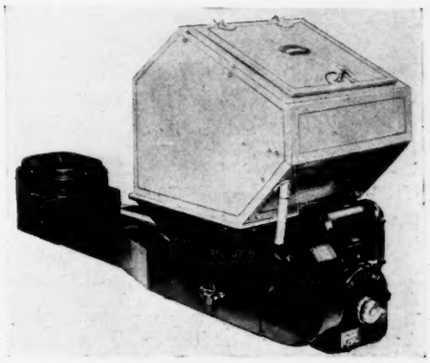
Triangular Masonry Drills

Triangular masonry drills, having three cutting points, have been introduced by The Rawlplug Co., Inc., 98 Lafayette St., New York. This unique construction is said by the manufacturer to result in superior strength, and permits resharpening on the job with any ordinary grindstone. The drill has straight sides and a sharp point, providing for accurate centering and drilling. It is further claimed that holes are bored more rapidly by this drill.

Frederick Stoker

Frederick Home stokers for domestic and moderate-sized commercial and industrial applications have been placed on the market by The Frederick Iron and Steel Co., Frederick, Md.

Fuel is fed to the retort by a helical screw revolving in a steel tube. Air for forced-draft combustion is conveyed from the fan to the retort through a welded steel duct, provided with a regulating damper. The feed screw is driven through a gear reduction system, enclosed in a hermetically-sealed box, and a safety shear pin and overload switch protect the mechanism against damage in the event of jamming.



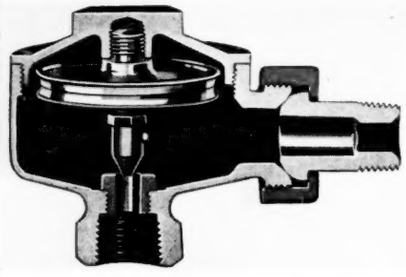
Frederick Home stoker

Coal hopper is of 500 lb. capacity of convenient proportions and height, and equipped with a rubber-sealed cover. A suction tube connected with the fan removes gases and dust from the hopper, preventing their leakage into the basement.

Radiator Trap Has Unusual Features

Illinois Series G inboard thermostatic radiator traps, a recent development of Illinois Engineering Co., Chicago, are especially designed to meet the requirements of rapid-condensing concealed convection heaters.

Thermostatic element consists of a duplex diaphragm arrangement, constructed of a rolled phosphor bronze alloy of unusual strength and



Illinois Series G radiator trap

temper. Strength and durability are further augmented by the design of the thermostat, according to the manufacturer, who states that the individual diaphragms are dieformed in a particular shape calculated to distribute the movement and strain throughout the entire surface. This results in a movement that is as near to being axially true as possible. The maximum movement of the extremely hard Nitralloy cone-type valve is 80% of the valve seat diameter, providing for removal of dirt and foreign matter when the valve is open. The thermostatic fluid used in the element is extremely sensitive to temperature change, a differential of less than 2° being required to fully open the valve. This compound will provide an internal excess pressure that parallels any operating pressure, permitting the trap to function equally as well at all steam pressures.

Traps are made in three sizes, capacities from 100 sq. ft. to 400 sq. ft., of direct radiator, at 2 lb. pressure.

Clarage Vortex Control for Fans

Vortex control, a new method of fan capacity regulation developed by Clarage Fan Co., Kalamazoo, Mich., is described by the manufacturer as possessing the low first cost advantage of damper control in addition to the efficient performance of variable speed control. Vortex control delivers any desirable capacity regulation with the fan operating at constant speed.

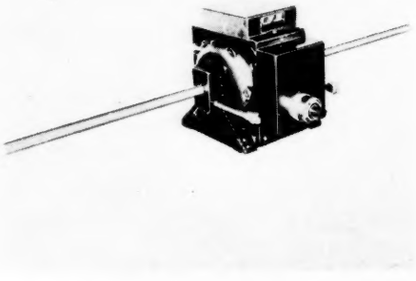
This control consists of radial vanes, either adjustable or stationary, mounted on the fan inlet. The vanes are wide at their outer ends, and taper to a narrow width near the axis. A rotary motion is thus imparted to the incoming air, and the volume of air handled is regulated by adjusting the relative speed of the air entering the fan with respect to the speed of the fan wheel. The manufacturer states that this control does not introduce additional resistance to the rotation of the fan as does the throttling action of a damper control. By moving the blades of the device, a fan operating at constant speed is given the characteristic of a fan operating at variable speed, and the fan characteristic becomes the same as the system characteristic.

Adjustable type controls can be operated manually or automatically, automatic control being available in a variety of forms. The stationary type can be furnished to limit the fan capacity to any percentage of full output, but is not subject to adjustment once installed.

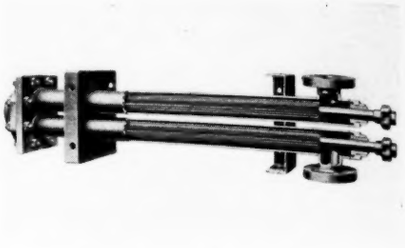
Fan Motor Has Extended Shaft

A low-speed, fractional horsepower motor, equipped with an unusually long shaft for direct drive of multiple fan and blower units in air conditioning apparatus, has been placed on the market by The Holtzer-Cabot Electric Co., 125 Amory St., Boston, division of The Gamewell Co., Newton, Mass.

Motor is of the single-phase, variable-speed, capacitor type, and is said by the manufacturer to be extremely quiet in operation. It is mounted on an all-metal resilient base which maintains the shaft in a fixed position.



Motor for blower drive



G-Fin tube fuel oil heater section

Griscom-Russell Announces Fuel Oil Heater

Twin G-Fin fuel oil heaters, recently placed on the market by The Griscom-Russell Co., 285 Madison Ave., New York, are said by the manufacturer to provide an exceptionally compact and flexible installation.

Units consist of two parallel steel pipes, each serving as a shell for a single G-Fin tube steam heating element, and having a return bend at one end and all inlet and outlet connections at the other. The G-Fin tube, having longitudinal fins providing an extended heat transfer surface more than eight times greater than the area of the interior cylindrical surface, is made in the form of a U-bend, or hairpin.

These units are standard and interchangeable, and can be arranged in series or in parallel as required by the application. Additional sections can be added at any time to an existing installation. This design makes it unnecessary to provide 100% spare heating capacity excepting in installations in which but a single unit is used. Thus, individual units can be cut in and out of service at fractional loads to better maintain constant oil temperature.

Absence of internal joints precludes the possibility of leakage between steam and oil, and the free expansion of both shells and finned tubes eliminates strains from changes in temperature.

Electrodes for Iron Welding

Ferroweld electrodes, for welding cast iron, are being marketed by The Lincoln Electric Co., Cleveland.

These electrodes are produced in one size only, 1/8 in., in 14-in. lengths,

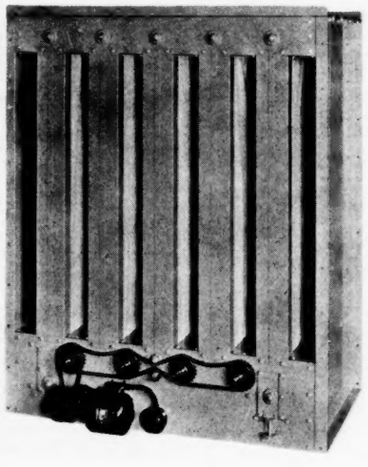
to be used with low heat to reduce the possibility of cracking the work and minimizing the hardening effect along the line of fusion. The electrode has a steel core surrounded by a heavy flux coating of uniform thickness, providing a shielded arc to protect the weld metal from contamination from the ambient atmosphere. The manufacturer states that Ferroweld provides a solid, dense weld, having greater tensile strength and ductility than the cast iron itself. It is used with a current of about 80 amperes, with work negative and electrode positive.

Filter Vacuum-Cleaned Automatically

An automatic, self-cleaning air filter for air conditioning installations has been developed by the Coppus Engineering Corp., Worcester, Mass.

Filtering medium consists of a wool felt curtain, arranged in an endless belt running over rolls. The edges of the filter curtain are reinforced by belts, which keep the filter laterally taut, and seal the edges against air leakage.

The four bottom rolls are connected by sprockets and chains to a small geared electric motor, and when the motor is set in operation, the filter curtain is passed slowly over a suction nozzle connected to a vacuum cleaner. The motor is started either by a time clock at regular intervals, or by the action of a sensitive pressure gauge whenever an accumulation of dust and dirt increases the resistance to a predetermined maximum. The vacuum cleaner is started simultaneously with the starting of the motor, and the automatic cleaning process is completed within 15 or 20 min., when the motor and vacuum cleaner are automatically stopped. The vacuum cleaning process is accomplished without removing the filter from service, the air cleaning process continuing without interruption. The manufacturer states that the wool felt curtain provides an unusually effective filtering medium.



Coppus automatic self-cleaning filter

Hoffman Improves Appearance of Valves

Hoffman Specialty Co., Inc., Waterbury, Conn., announces that its No. 1 siphon air valve and No. 2 vacuum air valve are now available with bronze, ivory, or black finish, harmonizing with three popular schemes of color decoration. Said by the manufacturer to be chip-proof, untarnishable, and softly lustrous, these new valve colors are baked on by a process which gives an etched appearance to the finish. The standard polished nickel valves will be continued.

Coupling Simplifies Pipe Joining

Straight plain end pipe can be joined without threading, grooving, beveling, upsetting the ends, or other finishing operation, by unskilled labor, with the Champion Positive Seal pipe coupling, according to the manufacturer, The Champion Machine & Forging Co., 3695 East 78th St., Cleveland. The company claims for the joint strength in tension superior to that of a threaded and coupled joint.

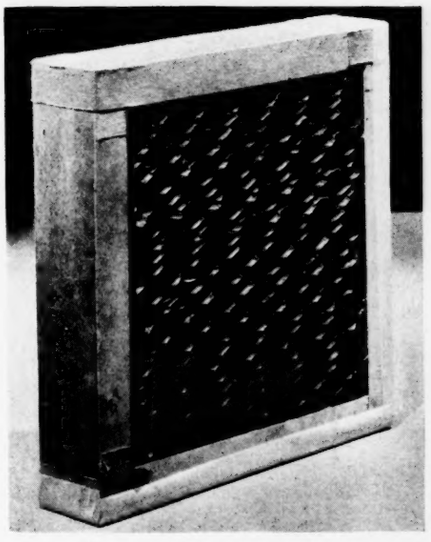
Coupling consists of five parts, comprising two half coupling sections containing gripping devices, one gasket with metal protected sections, and two bolts. Coupling sections are of drop forged steel. Gripping rings are drop forged and heat treated and assembled into the coupling sections to form an integral part of the coupling itself. The gasket is designed to provide a double seal, equally effective against either pressure or vacuum. Two steel reinforcements on the gasket protect it from the pinching action of the coupling during assembly.

Arco Filters Announced

A replacement type of air filter, available in types for both furnace and commercial applications, has been announced by American Radiator Co., 40 West 40th St., New York.

Arco air filters are composed of two wafers of corrugated paper strips, laminated in such a way as to form tubular passages. The wafers are placed in frames so that these passages are at an angle of 90° to each other, with space intervening, so that air passing through the first must change direction before entering the second pass. The paper is coated with a compound which retains its viscosity at all temperatures ranging between 10° and 180°. As dust is deposited on the surfaces of the passages, the oil is absorbed by capillary attraction into each dust particle, and the dust accumulation then becomes a medium for catching other dirt.

The manufacturer claims that this filter has at least twice the life of any other throw-away type of filter. It is available in sizes 20 in. by 20 in., 16 in. by 20 in., and 16 in. by 25 in.



Arco air filter

January Degree-Days Below Normal in Most Cities

	Atlanta	Baltimore	Birmingham	Boston	Buffalo	Chicago	Cincinnati	Cleveland
Degree-days for January, 1934.....	611	805	510	1098	1098	1013	898	989
Degree-days, Sept. 1, 1933 to Jan. 31, '34	1512	2473	1182	3521	3738	3297	2723	3142
Degree-days, Sept. 1, 1932 to Jan. 31, '33	1668	2222	1489	2694	3261	3307	2771	2918
Comparison, season to date with last, %	— 9.4	+ 11.3	— 20.6	+ 30.7	+ 14.6	— 0.3	— 17.3	+ 7.7
Degree-days, Sept. 1 to Jan. 31, Normal	1813	2619	1502	3280	3611	3487	2795	3365
Comparison, season to date with nor'l, %	— 16.6	— 5.6	— 21.3	+ 7.3	+ 3.5	— 5.4	— 2.6	— 6.6
Lb. coal per sq. ft. rad., January, 1934	4.888	6.440	4.080	8.784	8.784	8.104	7.184	7.912
Gal. oil per sq. ft. rad., January, 1934	0.419	0.552	0.350	0.753	0.753	0.695	0.616	0.678
Cu. ft. gas per sq. ft. rad., January, 1934	58.66	77.28	48.96	105.41	105.41	97.25	86.21	94.94

	Davenport	Dayton	Denver	Des Moines	Detroit	Duluth	Fort Wayne	Grand Rapids
Degree-days for January, 1934.....	1061	941	774	1136	1081	1540	1028	1053
Degree-days, Sept. 1, 1933 to Jan. 31, '34	3373	2982	2282	3501	3503	5452	3384	3633
Degree-days, Sept. 1, 1932 to Jan. 31, '33	3463	2915	3413	3777	3353	5277	3347	3455
Comparison, season to date with last, %	— 2.6	+ 2.3	— 33.0	— 7.3	+ 4.5	+ 3.3	+ 11.0	+ 5.2
Degree-days, Sept. 1 to Jan. 31, Normal	3685	3063	3355	3762	3585	5161	3414	3659
Comparison, season to date with nor'l, %	— 8.5	— 2.6	— 32.0	— 6.9	— 2.3	+ 5.6	— 0.9	— 0.7
Lb. coal per sq. ft. rad., January, 1934	8.488	7.528	6.192	9.088	8.648	12.320	8.224	8.424
Gal. oil per sq. ft. rad., January, 1934	0.728	0.645	0.531	0.779	0.741	1.056	0.705	0.722
Cu. ft. gas per sq. ft. rad., January, 1934	101.86	90.34	74.30	109.06	103.78	147.84	98.69	101.09

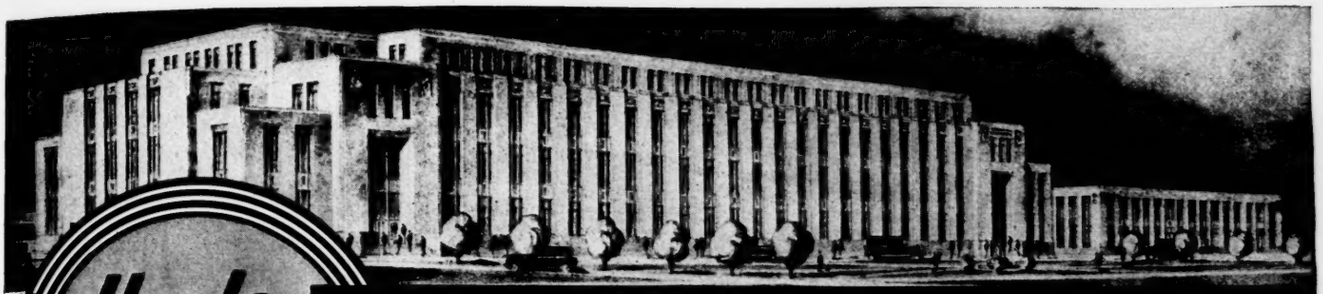
	Harrisburg	Hartford	Indianapolis	Kansas City	La Crosse	Los Angeles	Louisville	Memphis
Degree-days for January, 1934.....	961	1091	959	909	1248	147	820	612
Degree-days, Sept. 1, 1933 to Jan. 31, '34	3102	3564	2947	2501	4159	570	2394	1575
Degree-days, Sept. 1, 1932 to Jan. 31, '33	2805	2965	3014	2887	4254	691	2490	1890
Comparison, season to date with last, %	+ 10.6	+ 20.2	— 2.2	— 13.4	— 2.2	— 17.5	— 3.9	—16.7
Degree-days, Sept. 1 to Jan. 31, Normal	3069	3316	3130	3229	4313	750	2526	1871
Comparison, season to date with nor'l, %	+ 1.1	+ 7.5	— 5.9	— 22.5	— 3.6	— 24.0	— 5.2	—15.8
Lb. coal per sq. ft. rad., January, 1934	7.688	8.728	7.672	7.272	9.984	1.176	6.560	4.896
Gal. oil per sq. ft. rad., January, 1934	0.659	0.748	0.658	0.623	0.856	0.101	0.562	0.420
Cu. ft. gas per sq. ft. rad., January, 1934	92.26	104.74	92.06	87.26	119.81	14.11	78.72	58.75

	Milwaukee	Minneapolis	New Haven	New Orleans	New York	Omaha	Peoria	Philadelphia
Degree-days for January, 1934.....	1091	1358	1033	235	953	1085	1034	844
Degree-days, Sept. 1, 1933 to Jan. 31, '34	3676	4485	3317	428	2964	3209	3237	2610
Degree-days, Sept. 1, 1932 to Jan. 31, '33	3646	4534	2824	736	2503	3487	3344	2245
Comparison, season to date with last, %	+ 0.8	— 1.1	+ 17.4	— 41.9	+ 18.5	— 8.2	— 3.2	+ 16.2
Degree-days, Sept. 1 to Jan. 31, Normal	3984	4550	3219	735	2910	3639	3606	2734
Comparison, season to date with nor'l, %	— 7.7	—1.4	+ 3.0	— 41.7	+ 1.9	— 11.8	— 10.2	— 4.5
Lb. coal per sq. ft. rad., January, 1934	8.728	10.864	8.264	1.880	7.624	8.680	8.272	6.752
Gal. oil per sq. ft. rad., January, 1934	0.748	0.931	0.708	0.161	0.653	0.744	0.709	0.579
Cu. ft. gas per sq. ft. rad., January, 1934	104.74	130.37	99.17	22.56	91.49	104.16	99.26	81.02

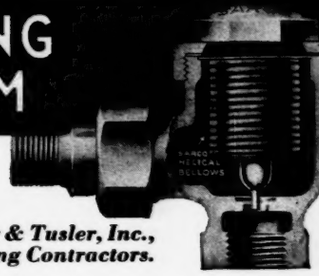
	Pittsburgh	Portland, Ore.	Providence	Reading	Rochester	St. Louis	Salt Lake City	San Francisco
Degree-days for January, 1934.....	971	563	1068	959	1161	842	930	407
Degree-days, Sept. 1, 1933 to Jan. 31, '34	3022	2097	3451	2948	3793	2443	2613	1271
Degree-days, Sept. 1, 1932 to Jan. 31, '33	2804	2412	2816	2669	3186	2617	3472	1454
Comparison, season to date with last, %	+ 7.8	— 13.0	+ 22.6	+ 10.5	+ 19.0	— 6.7	— 24.8	— 12.6
Degree-days, Sept. 1 to Jan. 31, Normal	3003	2530	3245	3102	3666	2798	3259	1414
Comparison, season to date with nor'l, %	+ 0.6	— 17.1	+ 6.3	— 5.0	+ 3.5	— 12.7	— 19.8	— 10.1
Lb. coal per sq. ft. rad., January, 1934	7.768	4.504	8.544	7.672	9.288	6.736	7.440	3.256
Gal. oil per sq. ft. rad., January, 1934	0.666	0.386	0.732	0.658	0.796	0.577	0.638	0.279
Cu. ft. gas per sq. ft. rad., January, 1934	93.22	54.05	102.53	92.06	111.46	80.83	89.28	39.07

	Scranton	Seattle	Spokane	Syracuse	Toledo	Trenton	Washington, D. C.	Wichita
Degree-days for January, 1934.....	1078	604	852	1160	1030	954	801	882
Degree-days, Sept. 1, 1933 to Jan. 31, '34	3559	2333	3136	3848	3399	3046	2510	2269
Degree-days, Sept. 1, 1932 to Jan. 31, '33	3174	2563	3530	3136	3299	2591	2349	2717
Comparison, season to date with last, %	+ 12.1	— 9.0	— 11.2	+ 22.7	+ 3.0	+ 17.6	+ 6.8	— 16.5
Degree-days, Sept. 1 to Jan. 31, Normal	3446	2656	3755	3768	3390	2774	2711	2877
Comparison, season to date with nor'l, %	+ 3.3	— 12.1	— 16.5	+ 2.1	Same	+ 9.8	— 7.4	— 21.2
Lb. coal per sq. ft. rad., January, 1934	8.624	4.832	6.816	9.280	8.240	7.632	6.408	7.056
Gal. oil per sq. ft. rad., January, 1934	0.739	0.414	0.584	0.795	0.706	0.654	0.549	0.605
Cu. ft. gas per sq. ft. rad., January, 1934	103.49	57.98	81.79	111.36	98.88	91.58	76.90	84.67

Fuel consumption figures given above are based on certain conditions, and for other conditions corrections must be made. The figures assume the use of steam radiators emitting 240 B.t.u. per sq. ft. per hr., a system operating at 100% efficiency, and radiators calculated for maintaining 70° in zero weather. Heating values assumed for the fuels are 12,000 B.t.u. per lb. for coal, 1000 B.t.u. per cu. ft. for gas, and 140,000 B.t.u. per gal. for oil. To correct for other heating values, efficiencies, and design conditions, follow the method explained in the "Heating and Ventilating Degree-Day Handbook."



Uncle Sam Uses SARCO HEATING SYSTEM



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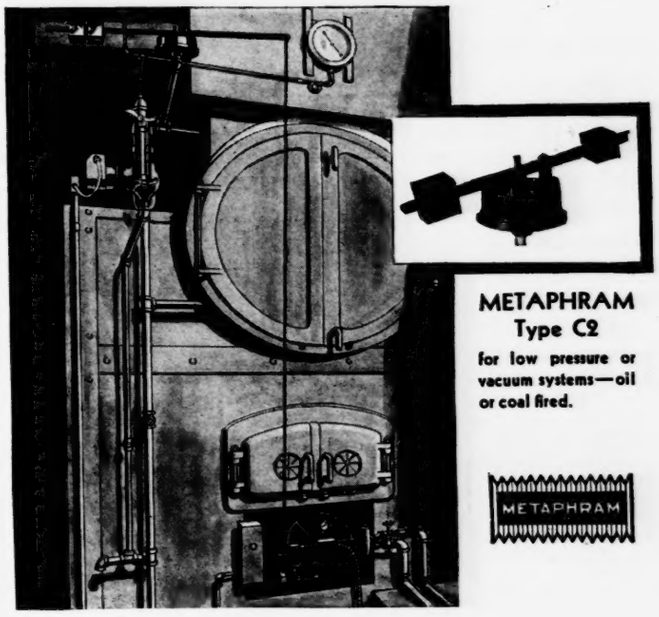

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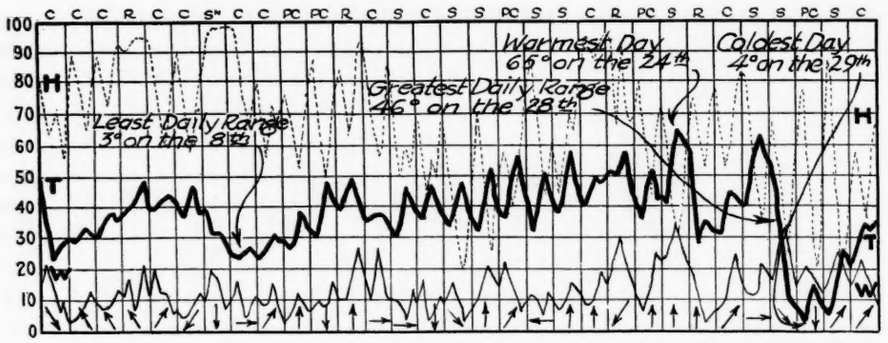
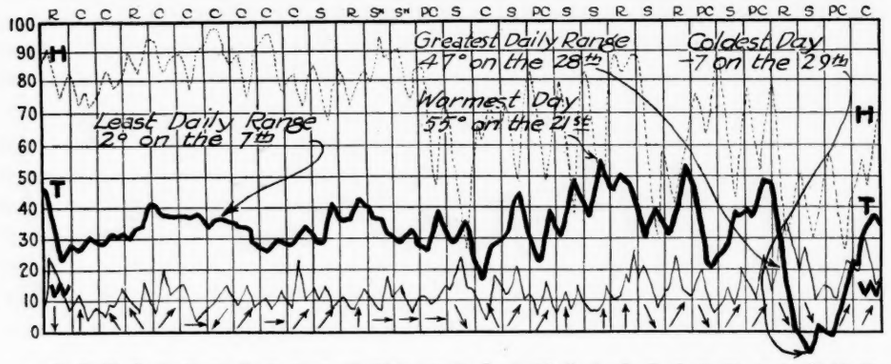
THE WEATHER FOR JANUARY, 1934

Plotted from records especially compiled for HEATING AND VENTILATING by the U. S. Weather Bureau. Heavy curves (T), temperatures in deg. F.; dotted lines (H), per cent relative humidity, from readings at 8 a.m., noon, and 8 p.m., except for New York, which shows hourly readings. Light lines (W), wind velocity in m.p.h. Arrows indicate prevailing wind directions. S—clear; PC—partly cloudy; C—cloudy; R—rain; Sn—snow.



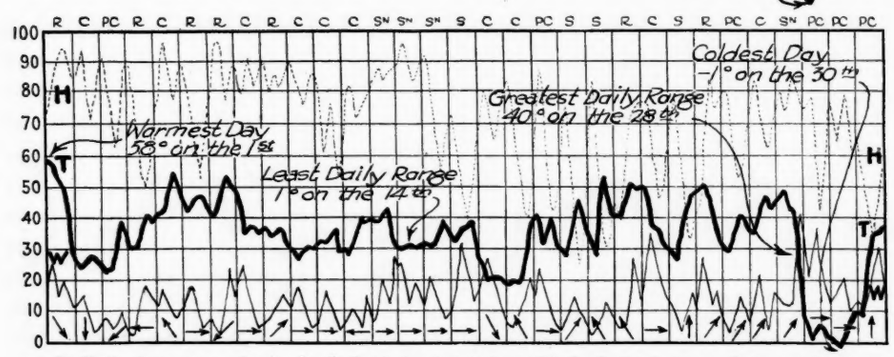
St. Louis

Mean temp. for month, 37.8°; aver. wind velocity, 12.3 m.p.h.; prevailing direction of wind, S.



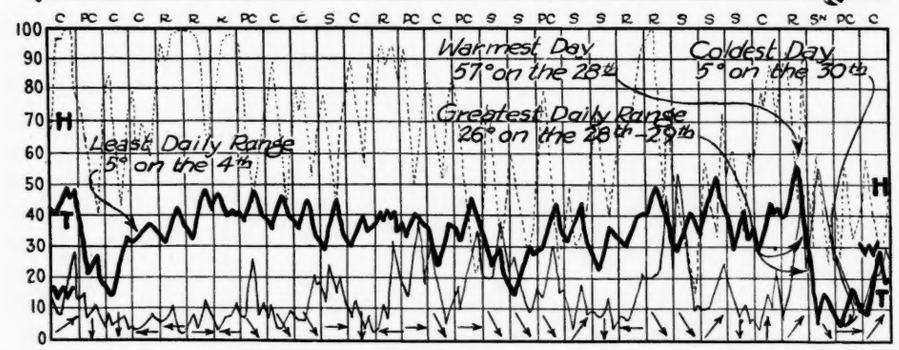
Chicago

Mean temp. for month, 32.3°; aver. wind velocity, 12.1 m.p.h.; prevailing direction of wind, S.W.



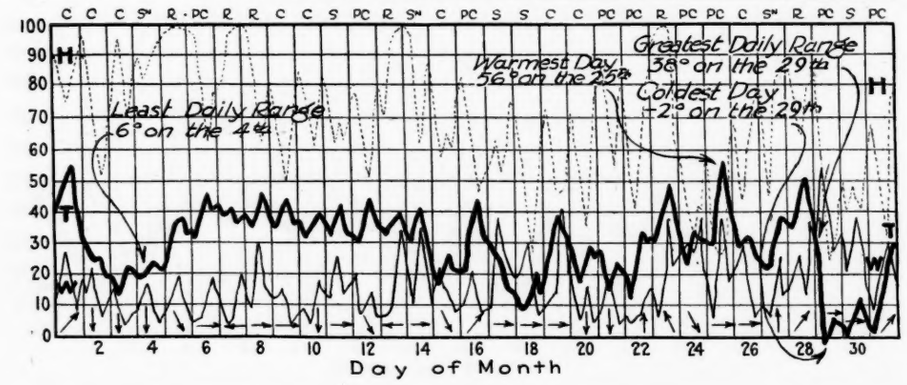
Pittsburgh

Mean temp. for month, 33.8°; aver. wind velocity, 11.7 m.p.h.; prevailing direction of wind, W.



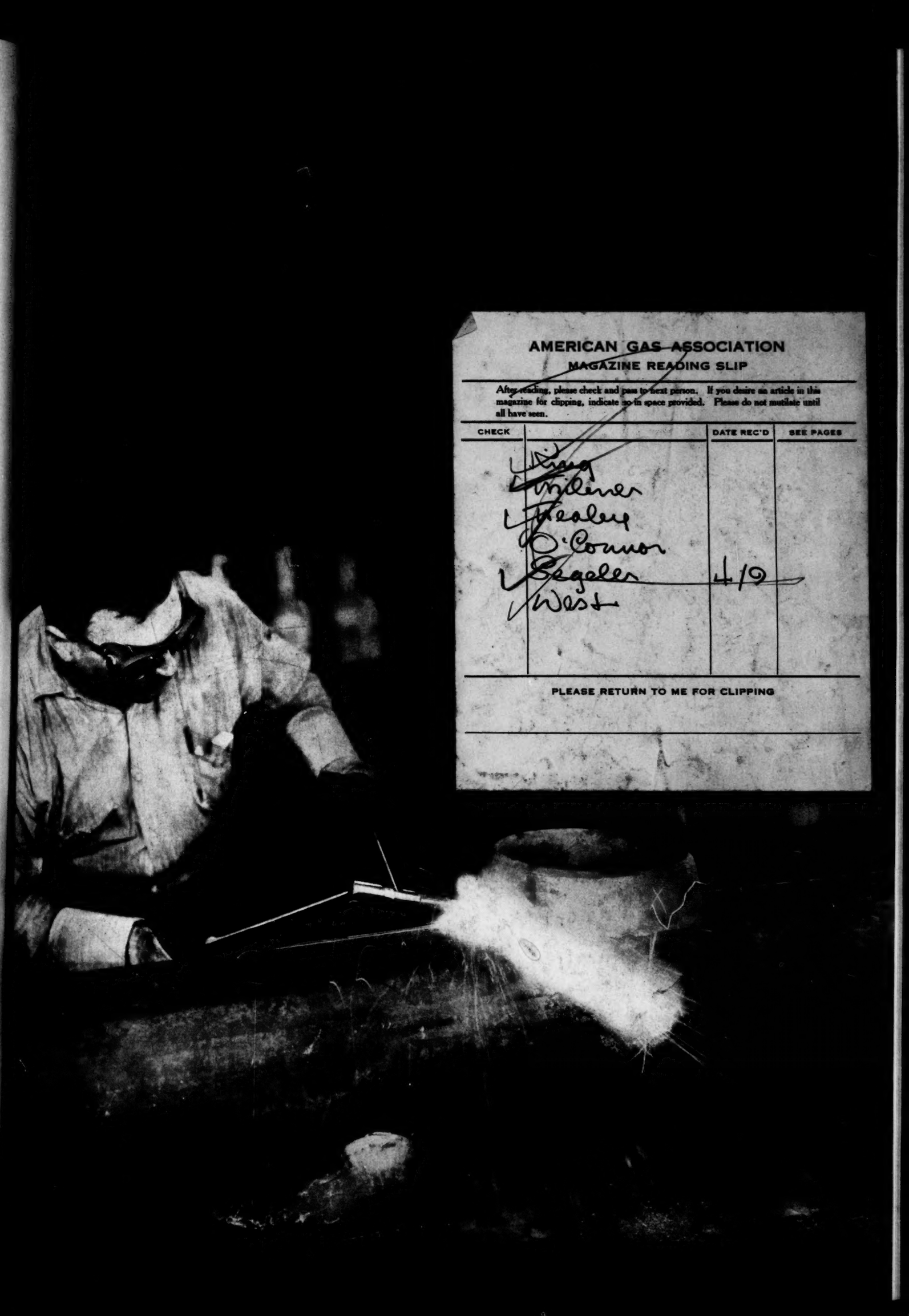
New York

Mean temp. for month, 34.4°; aver. wind velocity, 13.9 m.p.h.; prevailing direction of wind, N.W.


Greatest Daily Range
38° on the 29th
Warmest Day
56° on the 25th
Coldest Day
+2° on the 29th
Least Daily Range
6° on the 4th
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Day of Month

Boston

Mean temp. for month, 29.6°; aver. wind velocity, 15.3 m.p.h.; prevailing direction of wind, W.



AMERICAN GAS ASSOCIATION

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